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Energy: Status and Developments--II

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ENERGY: STATUS AND DEVELOPMENTS--II

CONTENTS

IMPROVED COAL UTILIZATION, PRODUCTION CONTINUES

Research Organization, Management

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] No 9, Sep 81 pp 57-58

[Article by Zhong Kecheng [6945 0344 2052] (edited by the staff of this journal): "The Organization and Management of Research in the Coal Industry"]

[Text] In recent years advanced coal-mining nations in the world are very concerned about the organization and management of coal resarch and treat the subject as a management science in their investigation. Valuable experiences have been generated for each nation's specific situation which should serve as a reference for us.

I. Organization and Work Division in Coal Research

The reorganization format of coal research should emphasize the proper handling of the interrelationship of research, development and production. Research in the coal industry should be approached from a pragmatic point of view, that is, (1) promoting a close relationship between research and production, (2) strengthening the coordination in scientific research, and (3) urging the industry to actively adopt new technologies.

In recent years foreign countries have taken the following effective measures in their research systems:

1. Establish research-production bases. The advantages of the research-production bases are the intimate matching between research and production and the great reduction in research time. For example, the Russian coal industry built a united company specifically devoted to the investigation of the mechanization of mineshaft auxiliary procedures. It is centered around a large scale research institute and the participation of design, development and production departments has reduced the time for developing new facilities by 50 percent. The United States has established even more research-production bases in government research centers, in corporate research institutes and in universities. Joint research is conducted for some highly interdisciplinary topics and large scale experimental facilities and computer centers are shared with high efficiency.

2. Establish research centers. These modern science and technology centers can not only concentrate man-power and resources in solving major problems in science

and technology but also promotes the intimate combination of scientific research and production. Today such centers are established in America, England, Russia, West Germany, Japan, France and Poland. In the United States, 4 research centers under the Bureau of Mines conduct mining research and the safety regulatory departments in the Labor Department also have technical service departments which carry out scientific research on safety. In West Germany, more than 50 percent of coal research projects are conducted jointly by this type of coal research centers and production plants of the coal industry. This kind of research organization effectively promotes the advancement of coal technology.

3. Adopt the contract system. A number of countries have adopted the contract system in improving the quality and efficiency of their coal research. The contract system is most popular in the United States. There are basically two types of contracts: In one type of contract the investment comes entirely from the government and a fixed compensation is usually made to the contractor in addition to the research costs. In the other type of contract both parties entering the contract share the burden of investment. This latter form of contract usually applied to the case where the production unit provides experimental facilities for the research project. A number of research projects are proposed by the research center which also provides the technical requirements and the work is contracted to private enterprises and universities which carry out the design, development, and testing, and present the research results. The job of the research center is mainly overseeing the technical standards and monitoring the execution of the research contract.

II. Organizing Research Plans and Research Projects

All the major coal-producing nations put great emphasis on the compilation of research proposals and plans. The general belief is that to develop coal research there should first be a proper goal and a practical research proposal. In foreign nations there are special institutions devoted to the study of "futurology" and research plans are made using systems engineering.

1. In a practical research project, there should be first a clear understanding of the key issues which have impacts on the development of the coal industry and then a program with well-defined emphases for short term and long term so that efforts can be focused in attacking the problem. It should be realized in planning a program that scientific research must lead the way for production construction whether the topic is key technical problems or long term economic construction.

2. Research plans in the coal industry are generally divided into short-term, mid-term and long-term projects. In England, for example, the plan is based on the projected production needs from 1985 to the year 2000. Short-term plans consider the topics of improved resource recovery and mining technology and the concentrated layout of mineshafts. Mid-term plans deal with the realization of remotely controlled and automated underground shipment and remote control of mining surface equipments. Long-term planning considers exploring the advanced experiences in other industries and transplanting it to the coal industry and topics such as mechanized mining using hydraulic power, broadened application of laser, and underground coal gasification. In any case, the actual contents of a research plan must be based on the specific situation of the nation and should not be forced to be

forced to be uniform. However, the principles of emphasizing short-term and long-term coordination and well-defined major efforts should be followed.

3. Material requirements of the proposed research plans are stressed in all nations. Budget requests are made simultaneously with the submission of the research proposal and the two are closely linked. Work can only be done within the means of funding. A research proposal that has a solid material backing is unlikely to be fruitless.

One important question in organizing a research plan is how to decide the main emphasis of the research. People abroad have considered this question from two standards, the so called internal standard and the external standard. The internal standard refers to the scientific field the topic belongs to and is concerned with questions such as whether the research has technically matured to the stage ready for development and whether the quality and quantity of the researchers engaged in this research are adequate to carry out the research and development tasks. The external standard can be divided into the scientific merit, the technical value and the social value.

All the major coal-producing nations emphasize basic research in their scientific research planning. The close relationships among coal production, processing and utilization and natural environment have been realized. In countries such as the United States and England, the ratio of basic research, applied research and development is roughly 1:2:5. The ai sen [phonetic] research center for coal in West Germany has approximately 1200 employers, out of which more than 1/3 of the employee efforts are in basic research.

While developing basic research, various nations have also realized that research topics should come from production practice. Many of the research topics in West Germany are technical problems in production urgently waiting for solutions. To solve the problem of excessive yield of coal powder in the rolling cylinder coal cutter, they have developed a disk coal cutter that has a powder yield 30 percent lower than that of a rolling cylinder coal cutter of equal power. The new type of coal cutter reduces the yield of grains 10 millimeter in size or smaller by 10 percent and improves the yield of 50 millimeter or larger coal grains by 27 percent.

The formation of an annual research plan should be based on a detailed study of the research topics of the previous year. Modifications should be made to various degree but the overall thrust should not be greatly different from that of the previous years. Plans are usually made every 2 or 3 years to maintain the stability of the research topics.

III. Organization of the Research Force

Excellence of the research team should be stressed and attention should be given to the development of various research forces. For example, special research companies, technical development departments of plants and mines and mining engineering departments of universities and colleges should each make their own contribution and complement each other. Scientific and research personnel specialties should be kept relatively stable and attention should be given to the cultivation and improvement of the research staff. Periodic training should be held for the

researchers whether they are engaged in basic research or in technical work in plants and in mines.

International collaboration should be improved. In organizing the research force, we should not only pay attention to the collaboration with departments outside the coal research system but also stress the effective department of foreign research. For instance, the United States is not familiar with technology of long wall mining, so, in addition to their own investigations they have also invited experts from the luer [phonetic] coal technology consulting company in West Germany and from the British mining consulting company to the United States for mine pressure investigation and solved the technical problems of shielded automatic translating carrier.

Experience shows that strengthened international collaboration in technology is an effective means to improve the quality of researchers, to accelerate the development of scientific research and to obtain research results as quickly as possible. It is receiving increased attention in many countries.

IV. Carrying Out the Research Work

The procedures of scientific research should be rigorously adhered to. In general, different procedures of investigation are proposed for the study of different topics. In England, regulations require that the testing of a research prototype must include laboratory tests, surface tests and running at the production site (including underground).

Scientific research funds should be applied in a concentrated manner and funding for major projects should be guaranteed. The funding sources for scientific research in major coal-producing countries are all allocated from the production cost and sale volume of coal, except for government investments in research. Many research institutes are themselves financially accountable enterprise units.

Modern scientific experiment facilities should be built up. A research unit is different from a production plant or a coal mine. It must have a certain amount of laboratory facilities and measurement equipment in order to develop its specialty, to accept experimental and testing assignments that cannot be achieved at the plants and mines and to present convincing scientific data.

Attention should be given to the role played by scientific and technological information. In the days of a rapidly developing coal technology, the role played by information is becoming increasingly prominent in the modernization of technology. Advanced coal-producing nations have already entered the age of "information-computer-telecommunications" and scientific management of technical information. Extensive information and data can be obtained rapidly and accurately. The strong sense of timing has further accelerated the development of research.

A system of periodic checking should be established. For the purpose of discovering problems in time to make rational adjustments to the project, many countries have established a periodic checking system. The coal mining research and development center in England reviews the research topics once every month and the highlight subjects once every week as a rule. Modified schedules are then printed out by the computer and distributed to the staff. Brief summaries are made every quarter and annual reports are submitted to the bureau of coal management for review.

V. Evaluation, Application and Promotion of Research Results

On the review and evaluation of research results, each country has its own strict requirements and rigorous standards. The evaluation is usually carried out by a special committee or an appointed research institute. In England the general bureau for coal management appoints the institute of coal mining and mining machinery design to conduct certification for all the new coal mining machinery in England. Only the certified products are allowed to begin mass production. This institute has very stringent requirements in evaluating the newly developed automatic translating carrier Ziyi Zhijia [5261-4448-2388-2665]. Numerous tests are performed on the components and on the whole machine, and some new carriers went through as many as 20,000 tests. Once certified, the research results should be fully used and promoted. In the United States, research results of the government become the government's patent and there are specific institutions in charge of the promotion and proliferation in industry. The bureau of mines of the U.S. Department of the Interior established special organizations as early as the beginning of the 1970's to promote research results.

In recent years, science and technology of the coal industry in China have progressed steadily and the management of coal research has also gradually established a regular system. With the benefit of foreign experience, it can be anticipated that the future organization and management of research in the coal industry will become increasingly scientific and modernized and new contributions will be made in promoting the science and technology of the coal industry in China.

9698
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Economic Problems Studied

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 7, Jul 81 pp 2-4

[Article by special commentator: "Actively Develop the Study of the Economic Problems of Coal"]

[Text] The coal industry is an important sector of our nation's national economy. Since the founding of New China, it has developed greatly, and it has contributed what it should to the building of our nation's socialism. At present, there is already a team of several million workers on the coal industry front. Known coal reserves amount to over 600 billion tons. The state invests heavily in the building of the coal industry each year, and the industry has become one with a relatively large amount of fixed assets and with a productive capability second only to the United States and the Soviet Union, ranking third in the world. Now, how to rationally develop and utilize such rich coal resources, how to rationally utilize such huge manpower, material forces, financial strength and productive capabilities, how to rationally transport, distribute and utilize such massive amounts of coal products, and in general, how to develop their greatest efficiency and achieve their greatest economic results are a series of important economic questions regarding coal which confront us and which we must study.

Developing coal must obey the characteristics of the distribution of coal resources and other economic and geographic conditions. For example, the coal resources in Shanxi are superior to all other regions and the construction cycle for developing coal in Shanxi is short, with less investment per ton of coal being required, equivalent only to 1/2 to 1/4 that of Hunan, Hubei and Zhejiang. The cost of exploiting a ton of coal is lower than the national average by 1/3, and lower than that in Hunan and Hubei and Zhejiang by 1/2 to 1/4. The material labor production rate of the coal miners in Shanxi is twice as high as that of Hunan and Hubei and Zhejiang. But, expanding the development of coal in Shanxi is limited by such natural and socio-economic factors as the regional economy, labor force, water resources, and conditions of transportation, etc. As Marx pointed out, the labor production rate is always linked to various natural conditions. "True wealth is to use the least amount of labor and time to create the most material wealth." Therefore, according to coal resources and different socio-economic conditions, studying the use of the same amount of labor (live labor and embodied labor) to obtain more utilization value and to reach the best economic results is one of the important tasks of studying the economics of coal.

But, for a long time, under the guidance and influence of the mistaken leftist ideology, development of the coal industry did not sufficiently follow the situation in our nation, it did not sufficiently follow the objective patterns of the coal industry itself, it was anxious for achievements in its guiding policy, it blindly sought high goals, and development of the coal industry was hindered. Especially during the ten years of the "cultural revolution," the coal industry suffered from serious interference, the leading group, the technical teams, the workers' ideology, the productive conditions, business management, regulations and systems were all severely destroyed. In particular, the imbalanced internal proportions of the coal mines worsened, safety conditions were poor, the loss of coal resources was great, wastefulness in capital construction was serious, the proper procedures of capital construction were violated, and the preparatory work of the early period was neglected. Frequently, projects were started hastily and carried out without preparation, and with the addition of poor management, the economic results were poor. In addition, the price of coal remained unreasonable for a long period, violating the laws of value. Problems of not adhering to the principle of distribution according to work existed in the wages and labor system. The production, supply and marketing system and the management system were not well matched, etc. All these affected the hastened development of the coal industry. These problems show that we have not yet recognized clearly the laws of motion in the economic sector of the coal industry, and this is mainly because we have not launched the study of the economic problems of coal well.

Yet, the important significance of understanding clearly the economic problems of coal in developing the coal industry has not yet been recognized by even more comrades. We believe, for the coal industry to realize modernization, the modernization of technical equipment, the modernization of economic management and high levels of economic results are all important signs.

Obviously, with modernization of coal technology and equipment but with backward economic management, the economic results will be very poor, and we cannot say that the coal industry has truly realized modernization. Technology and economics are mutually stimulating, mutually dependent and mutually limiting. Science and technology serve economic buildup. They are "powerful levers" to stimulate

economic development. What the economy needs is a technologically advanced motive force and direction. Technological progress is in turn the important condition and means to push economic development forward. Any technological reform and the realization of technological measures are all inseparable from economic conditions. Similarly, an economy unrelated to science and technology cannot exist. Under all conditions, people must use definite technology to achieve a definite goal and to satisfy a definite need. The social practice of any technology must consume manpower, material force and financial force under all conditions, and it must combine man, materials and technology as well as possible under a definite environment to develop their functions to the maximum extent. A lot of advanced technology frequently produces a very good economic result, but, because of the influence of various internal and external factors, technology and economy frequently possess the mutually limiting side of opposing each other and conflicting with each other. For example, under certain conditions, the technology may be advanced, but the economic results are not good. This limits the development of this type of technology. It can thus be seen, seeking the objective patterns of the rational relationship between technology and the economy and finding the best relationship so that technology and economics can mutually adapt to each other well is precisely the major problem of the economy of coal we want to study. Therefore, to promote the development of coal science and technology and to realize modernization of the coal industry, the development of the study of the problems of the economics of coal is needed even more.

The subject and the goal of studying the economics of coal should be a discussion of the link between the reproductive process of coal and economic problems, and we should take the economic effects and economic management problems in the process of reproduction of coal as the subjects. Coal economics, that is, coal technical economics, is the study of the economic questions of coal production and productivity, while coal economic management is the study of how to rationally organize the productivity of the coal industry, consolidate perfecting the economic relations of the coal industry (productive relationships), readjusting the superstructure's timeliness (such as the set up, plans, system, pricing policies, etc.) to suit the needs of development of the productivity of coal. Therefore, to study the economic problems of coal is to study the objective laws of the reproductive process of coal from the economic viewpoint, and using this law to form the best combination between the appropriateness of technology of the reproductive process of coal and the rationality of economics. For this, the task of studying the problem of the economy of coal is to show the economic patterns in the reproductive process of coal, to determine the plans to increase the productive efficiency of coal, to select the best economic results in productive construction, to improve the organization and plans for production, to point out the direction and the path to hasten the development of production, to make decisions to develop the coal industry and to provide a basis for establishing the most suitable technical and economic policies and management systems and to propose theory and methods to study the economics of coal.

We believe the content of studying the economic problems of coal is very broad. We must grasp the key points, emphasize the urgent problems that we face at present in our studies, and we must also consider the need to develop sectoral economics and to carry out overall research according to plans.

First, we should study the concrete theories and scientific methods of economic problems of coal. This should not be neglected. Because, without the guidance of basic theories and scientific methods, other research will not have anything to follow, and it would be difficult to judge their scientific nature and their correctness. The theory and method of studying the economic problems of coal must be guided by the general economic theory of Marxism, to absorb the advanced theory related to sectoral economics abroad and at home, and combine the concrete conditions and characteristics of our nation's coal industry, conscientiously summarize the social practices in the coal industry of 31 years, and to seek out the useful theories and methods from the valuable experiences, both positive and negative.

Second, to study the economics of coal resources, we must mainly study the socio-economic uses and the technical and economic effects of coal resources. For example: 1. the regional distribution of coal resources and the geo-economic distribution of coal resources, the forecasting of trends and needs for coal resources; 2. economic zoning of coal resources; 3. technical and economic evaluation of coal resources, i.e., to analyze, prove and evaluate the feasibility from the technical and economic viewpoints the usability and ways to utilize coal resources; 4. to explore the value of coal resources in economic theory and the problem of compensatory use, etc.

Third, the development of the economic study of coal technology should emphasize the problem of economic results in the buildup of coal production. This should be the core of studying the economic problems of coal. We must not only study its nature, the system of indicators of economic effects, and the methods of evaluation and calculation, we must also carry out qualitative and quantitative comparison according to scientific regulation in considering concrete problems, determine various technical plans, technical measures and technical policies and their optimization. The subject of the economic problems of coal technology includes many areas, for example: 1. the rational development and distribution of coal resources, i.e., under different conditions, which technical method of development is rational, how to overcome the uneven distribution of the resources and how to effectively develop the desired effects of distribution, how large should the scale be to be economical, what type of wells and what intensity of development and how many years of service would be economical, policies that rationally develop regional coal mines; 2. the study of the effectiveness of investment in capital construction of coal enterprises, including the system of indicators and goals, and the methods of evaluation; 3. the problems in coal production, such as the rational utilization of productivity, the pattern of balanced production and the rational policy of digging for potential, renovation and reform, the rational criteria for the retrieval of coal resources, the ways to increase the labor production rate, etc.; 4. the rational scope of coal processing and washing, the rational structure of products, the rational utilization and comprehensive utilization of coal; 5. the policy questions concerning the development of coal science and technology, for example, whether to develop suitable technology or advanced technology, whether to rely on oneself or to introduce foreign technology, how to adapt introduced technology to our national situation and how can we adapt to the trend of international development, thus hastening the development of coal production in our nation and promoting the development of technology; 6. the study of how to correctly handle direct results and indirect results, immediate results and long term results, the relationship between macroeconomic results and microeconomic results, etc.

Fourth, research in economic management of coal should be carried out. The problems that need to be studied in this regard are broad, mainly problems of business management for coal, the system of economic management, the internal and external economic relationship and the series of economic policies. For example, the policy of protection and utilization of coal resources, the problems of the structure and the management system of coal, the rational system for production, supply and marketing, how to use economic methods to manage the economy of coal, the problems of the export of coal and foreign trade systems for coal, the analytic study of the production costs of coal, the ways to reduce cost, rational labor, wage and welfare policies for coal mines, coal pricing policies and other economic policies, the source and rational utilization of capital for buildup of coal, the policy of international cooperation and joint management, the relationship between the development of the coal industry and science, education and environmental protection, the rational economic relationship between the coal industry and other related sectors of the national economy, and the future for developing coal as the main energy resource and as industrial raw materials, etc.

If the above problems are studied clearly and their patterns grasped, then there will be freedom in managing the coal industry well.

At present, the study of the economic problems of coal is a very important and mighty strategic task. It relates to the future development of the coal industry. Therefore, we must organize our forces well to actively begin research. At present, we should organize appropriate forces in the departments of scientific research, design, geology and various economic management departments and concerned schools, and we should rely on scientific research forces in society, combine their efforts with actual problems, start out by studying specific topics, and after obtaining some results, we must first compile collected works on special topics in the economic research of coal, and on the basis of further systematic study, gradually form a more complete coal economics, then further enrich and improve it. For this, we must have a broad number of people willing to serve as scientific, technological and managerial cadres to widely carry out research, and we must also organize specialized teams to carry out systematic and in-depth research.

The characteristics and demands of research in the economics of coal are different from those in the research of coal technology. To the researcher, he is required to understand technology and also understand economics, the knowledge must be broader, and he must possess the ability to analyze and synthesize. This requires selecting a backbone team from cadres with scientific and technological and managerial experience, and at the same time to provide them with other necessary specialized personnel to carry out research together. In the method of research, the economic research of coal must emphasize investigative research and analysis, comparison and computation.

The other characteristic of economic research of coal is the wide scope and its involvement with the current system and policies of the state and the sector. Economic research is not the proving and the explanation of current policies. It must start out from the actual situation, it must start the engines, conscientiously study, speak the truth, judge by seeking truth from facts and judge scientifically, say whatever comes to mind, have the courage to propose opinions and suggestions of a policy nature having a scientific basis, and contribute towards the realization of modernization with one's own scientific research achievements.

At present, in the development of research in the economy of coal, although there still are some difficulties, for example: a few comrades do not have sufficient understanding and do not place sufficient emphasis on it, the research strength is weak, the organization and agencies are not sufficiently sound, basic work is poor, information is deficient, there is a lack of mature theory and method, etc., but now, there are many beneficial conditions, the party and the state emphasize economic research, there are some economic research agencies that have been established one after the other, such as the National Technology and Economic Research Center, which is the authoritative information and consulting organ on national policies concerned with technology and economic policy. The state has also gradually established some systems to promote the emphasis on economic research. The leadership of the coal ministry has emphasized research in the economy of coal, and recently, it has proposed concrete tasks to the scientific and technical departments to study and establish Chinese coal economics. In addition, the social practices of 30 years by the coal industry have accumulated rich positive and negative experience which can be utilized. The broad numbers of scientific and technical and managerial cadres are enthusiastically concerned with research in the economy of coal, and they have a great enthusiasm. Now, the key is to organize the forces. As long as we act and persist, we will definitely be able to develop research work in the economy of coal, gradually understand clearly the important economic problems facing us, grasp the patterns of the economy of coal in China, and promote the modernized buildup of the coal industry.

9296
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Symposium on Coal Utilization

Beijing MEITAN XUEBAO [JOURNAL OF CHINA COAL SOCIETY] in Chinese No 2, 1981 pp 67-68

[Article by Hang Jinhe [2799 6855 0735]: "Brief Report on the Symposium on Rational Coal Utilization"]

[Text] The China Coal Society, the China Metals Society, the China Chemical Engineering Society, the China Environmental Sciences Society and the Beijing Energy Society held a "Rational Coal Utilization Symposium" from 7 to 13 January 1981 in Changsha, Hunan. Some 150 specialists, professors and engineering and technical personnel involved in coal processing, metallurgy, chemical engineering, combustion engineering, environmental sciences and energy resources technical and economic research from all over the country participated. A total of 75 papers and reports were received. Their contents included: The country's basic coal production and utilization situation; rational utilization of refining coke and metallurgical conservation; new developmental research on coal gasification and liquification and mixed combustion of coal and gas; low caloric content coal combustion techniques and residue utilization; conservation of coal for use by the public; and the development of shaped locomotive fuels and the effects of coal processing and utilization on environmental pollution and environmental protection.

An extensive discussion of techniques and approaches for rational coal utilization was conducted at the conference, and it was concluded that rational coal utilization is a highly integrated scientific-technical and economic-mangement undertaking which

includes such problems as production and supply of coal, its processing and utilization, human livelihood, and environmental protection. Performing effectively the work described below in keeping with our country's specific conditions will be an important approach to rational coal utilization.

1. It is necessary to intensify screening and classifying, increase the number of varieties, improve quality, improve the coal product structure, and rationally adjust coal prices. Many representatives pointed out that much industrial equipment which uses coal as a fuel or raw material has specific technical requirements regarding coal quality, and if the coal mines provide varieties of coal suited to the charcteristics of this industrial equipment it will be possible to get full efficiency from it and to achieve outstanding conservation results. It was suggested that the coal production departments should make an effort in this direction and create favorable conditions for coal conservation.

2. The coking industry should be steadily developed in a planned fashion. Setting up joint coking and chemical engineering enterprises in coke-producing mining districts for the purpose of producing various types of coke, municipal coal gas and chemical engineering products is an important way of making rational use of coal. It was suggested that certain local coke producing facilities which waste rather large amounts of coking coal should convert as rapidly as possible to mechanized coking so as to save coal and protect the environment.

3. We should promote actively the use of the blown coal powder technique in blast furnaces. This is an effective way of saving coal in the metallurgical industry, but to extend the use of this technology it is necessary to solve the problem of declining coal powder quality. It was suggested that the metallurgical departments propose quality requirements for coal powder to be used in this technology and that the coal departments set up the requisite classifying and screening plants.

4. An energetic effort should be made to fix the supply of coal for coal-fired electric power stations in terms of quality and amount. Electric power stations may efficiently burn low caloric value coal, but the quality of the coal supplied must be stable to assure normal boiler operation. If this work can be done, a 3 percent economic effect can be realized in coal conservation.

5. This country produces large quantities of low caloric-value coal, including brown coal, coal washings and gangue, which should be used locally in accordance with local conditions, in an effective manner. In addition to using its heat content, effective comprehensive utilization of coal ash and cinders must be achieved; use of coal ash in concrete and other building materials is an important method which should be energetically popularized. This is the key to economical utilization of low caloric-value fuel.

6. Developmental research on new coal conversion technologies such as gasification and liquification must be pursued. Liquification and gasification have the advantages of improving the coal's caloric content and overall utilization efficiency, ease of concentration which solves environmental pollution problems, alleviation of the load on transport facilities, and adding to the supply of fluid fuels and chemical

engineering raw materials. At present, not only must there be no slackening of scientific research work in this area, but an energetic effort must be made with modern techniques. Because the research period for coal conversion technology is rather long, it is suggested that arrangements for this kind of scientific research work be made well in advance.

7. Developing formed fuels is an important approach to efficient utilization of coal by the populace. In recent years, our country has had great achievements in the development of honeycomb briquets, and it is suggested that this technology be energetically popularized. The development of municipal coal gas should be gradually pursued in keeping with the nature of coal reserves and the needs of municipal construction. The technical approach should not be limited to a single method: Several programs should be compared and the most economical and efficient process selected.

8. A contingent should quickly be organized to pursue work on coal combustion technology. More than 80 percent of the coal produced in this country is used as fuel, but scientific research work in this area has not yet been organized, so that many problems such as low combustion efficiency and serious pollution have not been resolved; it was suggested that scientific research in these areas be quickly pursued.

9. Sufficient attention should be devoted to environmental pollution resulting from the use of coal, and early prevention and treatment measures taken. Many repreentatives pointed out that coal is the greatest pollution source in our country at present, and all of the various links in the coal production process and all coal processing methods lead to environmental pollution, so that environmental evaluations should be made of all the main enterprises making concentrated use of coal, and early protection and treatment measures should be taken to avoid grave consequences.

10. Technical and economic studies of coal utilization should be undertaken. The conference participants concluded that efficient utilization of coal involves not only technical questions but many economic and management questions. While pursuing technical and economic studies on energy sources, we must effectively link technology and economics, respect science, seek the truth from the actual situation, take a prudent approach and avoid one-sidedness. In view of the fact that technical and economic research on energy resources in this country are still weak, it is suggested that this type of scientific research work by strengthened in the future.

The participants all concluded that because rational coal utilization affects many departments, it is extremely necessary that various scientists and experts be invited to discuss problems of common concern. Many representatives believe that such a multidisciplinary conference is a rather effective professional activity and suggested that such conferences be held regularly in the future.

8480
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Rational Use Studied

Beijing RENMIN RIBAO in Chinese 28 Jul 81 p 3

[Article by Xie Xiaowen [6200 2556 2429] of the Planning and Design Institute of the Ministry of Coal Industry: "Use Coal Rationally"]

[Text] In terms of the technological standard of today's world, it is a big waste to use coal just as a fuel. Only when coal is used in an integrated fashion, where it is used as a thermal energy source as well as a chemical and metallurgical industrial material, can one say that it is fully used. Scientists have made the following comparison: if the value of using coal as a fuel is taken to be 1, then the value is 10 when coal is processed into coal tar, the value will be 90 if processed into plastics, 375 if synthesized into dye and 1,500 when synthesized into fiber. Therefore, all countries in the world are studying the rational use of coal.

China has abundant coal resources, it has a large coal reserve, a broad distribution and a complete variety, and the production volume is high. Although quite a few achievements have been made in the rational use of coal, there still remain a number of problems. For example, great amounts of coking coal are burned as non-coking coal, primitive coking methods are greatly promoted, coal utilization rates in both the industrial and civilian sectors are too low, quality of the produced coal is poor, utilization efficiency cannot be improved, and smokeless coal and brown coal have not achieved effective utilization.

It can be seen that there is great potential to be developed in China's coal utilization. Take the case of brown coal. It has a moisture content as high as 30 to 40 percent and a calorie value of only 2,000 to 3,000 kilocalories per kilogram, and has long been regarded as a low grade coal and received little attention. But, in fact, it is only necessary to first make brown coal into low calorie value coal gas and then generate electricity with the composite combustion gas-steam cycle for the thermal efficiency to reach 40 to 45 percent, twice the average thermal efficiency of today's coal power plants in China. Furthermore, when coal gas is piped into the cities for industrial and civilian use, it saves more than 50 percent of coal as compared to burning honeycomb coal. In addition, brown coal is a good material for coal gasification. When gasified in-situ, it not only produces high calorie value fuel with low ash and sulphur content, but also produces high grade material for coking, carbon material and carbon fiber, depending on the operating conditions. It can also be used as boiler fuel or further hydrogenated to produce high grade gasoline and other valuable chemicals. With advanced scientific technology for rational use of coal, even low grade coals are valuable, not to mention high grade coals.

In order to achieve rational use of coal in China, the previous development policy based on coking coal should be adjusted. Brown coal and non-coking coal, which are suitable for open pit mining, should be given priorities. This will not only rapidly increase the production of non-coking coal and brown coal, it will also provide a material basis for the rational use of various kinds of coal.

Next, dressing of all the raw coal should be systematically and gradually achieved to improve coal quality. Matching and distribution of production and demand should be made to satisfy the needs of different consumers to improve the utilization rate of coal.

Finally, scientific research should be strengthened to improve the technology of coal utilization and gradually achieve the conversion of coal into a secondary energy source and greatly improve the industrial and civilian heat energy utilization rate. That is, based on the different coal resource conditions at various places, united enterprises of electric power generation, coking, coal gas and coal gasification should be developed according to the location to achieve a truly rational use of coal.

9698
CSO: 4006/500

Coal-Oil Mixed Fuel

Beijing RENMIN RIBAO in Chinese 28 Jul 81 p 3

[Article by Ma Yuanji [7456 0337 7535] of the Physics Department of Zhejiang University: "Attention Should Be Paid to Mixed Fuels"]

[Text] Since the 1970's, because of the oil crises many nations have once again put the utilization of coal in an important position and actively searched for ways to substitute oil by coal. One of the new technologies developed in recent years is that of coal-oil mixed fuel, which is an effective transitional measure from oil to coal.

The so-called oil-coal mixed fuel is obtained by adding 20 to 45 percent of fine coal dust into the fuel oil, then homogenize it to a mud-like mixture. It can be used in fuel oil devices such as oil-burning boilers, blast furnaces, smelting furnaces and heating furnaces. When mixed fuel is used in oil-burning furnaces, it generally reduced the fuel oil consumption by 20 to 25 percent, and there is basically no need to modify the structure and size of the boiler. This has opened up the road toward substituting coal for oil. With a brief down-time and a small investment, equipment modifications can be easily made without affecting the output and efficiency and the original oil-burning system and storage facility can be used as well.

In recent years many industrially developed nations have put great efforts into research on coal-oil mixed fuels. Three international meetings were held since 1976 for technical exchange of mixed fuel technology. Today, mixed fuel technology has advanced to the experimental stage of broadening the application in large boilers and blast furnaces.

In China the experimental research of mixed fuel is already underway. Since 1979, the Chinese Academy of Sciences, Zhejiang University, Qinghua University and Yangshupu Power Plant in Shanghai have all obtained results in the investigation of the properties, manufacture process, transport and storage of coal-oil mixed fuel and

presented technical papers in international coal-oil mixed fuel technology exchange meetings held in 1980 and 1981. Now the laboratory research has been completed, and intermediate tests will be conducted. The success of coal-oil mixed fuel technology can be expected.

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Mine Flooding Prevention

Beijing GUANGMING RIBAO in Chinese 27 Oct 81 p 2

[Article by Wu Zongze [0702 1350 3419] and Li Linhe [2621 2651 3109]: "Strengthen Mine Flooding Prevention"]

[Text] A national conference on mine flooding was held early September in Jiaozuo Municipality. Experts attending the conference unanimously urged improvements in the prevention of mine flooding.

The hydrogeological structures of coal seams in China are complex and underground water often appears in mine shafts. As the depth of digging gradually increases, the flooding problem has become more serious and is now an outstanding obstacle to China's coal production and a threat to the workers in the safe production of coal.

The conference was centered around the topic of flood prevention in mine shafts and in-depth investigations were conducted from different aspects.

Experts believe that the primary requirement for the prevention of mine flooding is a thorough investigation of the hydrogeological conditions of the area. This is an elaborate task and can only be carried out properly with the collaboration of survey, production, research and education departments. To this end they recommended that the State Planning Commission, the Sate Energy Commission, the State Scientific and Technological Commission and the Ministry of Coal Industry include the prevention of mine flooding into their long term and annual plans, give it unified and overall consideration and planning and complete this task together. In the meantime, establish a national organization, round up specialists, form a task force and conduct investigation of common problems on a typical mine area with major water problem, then, summarize the experience gained in the study to advise the flood prevention work in other mining areas.

The experts also suggested the Mnistry of Coal Industry and its associated colleges and universities to add hydrogeology and production geology specialties, provide training for existing personnel and fundamentally change the serious shortage of mine shaft flood prevention specialists in China.

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Losses During Shipment

Beijing RENMIN RIBAO in Chinese 14 Sep 81 p 2

[Article: "Alarming Loss of Coal During Shipment"]

[Text] The loss of coal in China during shipment is extremely serious. According to reports from Jiangsu, Zhejiang and Guangdong provinces, the loss of coal during shipment by railroad has uniformly gone up. The loss rate in recent years is generally in the 1.35 to 10 percent range with an average of 4 to 5 percent. Based on a 4.8 percent loss, the total annual loss of railroad transported coal in 1979 and in 1980 both exceeded 20 million tons. In an article entitled "Railway coal cart" published in the August 1980 issue of the Railroad Technology News magazine, it was pointed out that the loss rate of transporting coal in open railroad cars is 3 to 4 percent and in some cases, as high as 5 percent. Using the 3 percent figure, the annual loss is 15 to 18 million tons. According to data from Guangdong and Zhejiang provinces, the loss of coal in the transportation by waterways is 3.85 to 12.15 percent. For one shipment of coal from Guizhou Province to Jiangsu Province by a waterway-railway combination, the loss was as high as 20 percent. If we take the average loss in waterway shipment as 6.7 percent, the annual coal loss in the past two years has exceeded 2 million tons.

The principal causes for the high rate of loss during shipment are the following:

In the shipment by railway the foremost problem is the serious damages of railroad vehicles. According to a survey made a few years ago by officials of the Beijing Railways Society, as many as 70 percent of the open railroad cars are faulty. Although there have been some improvements in recent years, the percentage is still alarmingly high. In September 1979, the Ministry of Coal Industry made a month-long statistical survey at 72 uniform allocation mines and found that 29.24 percent of the railways carts entering the mines are handicapped by holes in the sides, missing doors, missing side panels and incomplete door latch parts; 41.41 percent of vehicles do not conform to specification. A total of 1.8 million train-times of broken and damaged vehicles entered the uniform allocation mines in China for one year, the figure is even higher when the nonuniform allocation mines are also counted. After these broken and damaged vehicles enter the coal mine, the holes need to be repaired and it takes great amounts of wood board, bamboo, straw, reed, strew and bamboo curtain, and wooden post. The coal mines in China suffer a loss of 50 million yuan per year on this item alone. Because so many vehicles are damaged or broken, there are still tremendous losses due to leakages in the shipment. Then there is the problem of poor management by the railroad. Some of the personnel at railroad stations take coal from the vehicles at will and some peasants near the station dig coal from the carts any way they can, then fail to plug up the holes, which causes coal to leak out all along the way.

The principal causes of the loss of coal transported through the waterways are as follows. First, the method of pushing staggered barges is being promoted for transportation on the Changjiang. Because there are frequent seasonal winds on the broad river surface, an average of 200 to 300 tons of river water will enter a 1000-ton coal barge. Upon arrival at Shanghai harbor, unloading cannot be done because of the water, which must be pumped out first. In pumping out the barge, small

grains of coal are pumped into the river together with the water. Second, in the loading and unloading operations at the sea port and at the relay and reception coal harbors, large quantities of coal are also dumped into the water because of defective loading and unloading machinery and problems in the operation. When we were at the coal wharves in zones 6 and 7 of the Shanghai harbor, we saw some small fishing boats in Huangpu Jiang surrounding the collier and collecting the coal which fell into the river. From data collected at the site, a small fishing boat can collect 1.5 to 2 tons of coal per day. The Shanghai Coal Construction Company has retrieved 10,000 tons of coal that fell into the river in one year. It should be pointed out that the amount of coal collected by small fishing boats is a small fraction; most of the coal that fell into the river was either swept away or settled to the bottom.

Energy resources are in short supply in China. Quality assurance of the transportation of coal energy resources and reduction of shipment loss are urgent current issues to be addressed and they are the principal energy conservation tasks of the nation that should not be neglected. Naturally the problem in coal transportation are very involved and their solution will require a certain process. Our recommendation of the administration of the nation is to conduct special meetings to understand the existing problems in this area, establish practical and workable methods and regulations and take forceful measures to gradually reduce the loss rate in shipment.

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Efficient Coal Heater

Beijing BEIJING RIBAO in Chinese 15 Sep 81 p 1

[Article by Peng Shuyun [1756 3219 0061] and Zhou Huiping [0719 1920 1627]: "Cheaper, More Efficient Coal Heater To Be Mass Produced"]

[Text] Yesterday the new model 81-4 coal heater was certified and approved for mass production by the supervising departments. This new coal heater is economic in coal usage, efficient in heating, low on smoke and coal gas, fast in starting, long on banked burning and esthetic in appearance.

At the present time, residents of Beijing generally use the so called "dual-purpose heater" for their cooking and heating. This type of furnace uses less coal than the honeycomb coal burner but it still consumes a fair amount of coal and it has the drawbacks of having a tendency to die out, and generating an excessive amount of ash and a high content of coal gas. In order to solve these problems, the science committee of Haidian Ward has made the development of a new coal furnace one of the principal items of its 1981 science and technology project and organized a new coal furnace task force consisting of 8 technical personnel from the Ganjiakou community union, the ward office for coal management and the ward bureau for environmental protection. They opened up their work under the guidance of two advisors, Wang Fengwu [3769 7364 2976] and Xie Yuebin [6200 1471 1755]. In the process of developing the new heater, they incorporated the advantages of the "coal-saving multiple-purpose heater" developed by Xie Yuebin and finally developed the new model 81-4 heater.

Scientific tests show that with banked fire this new type of coal heater produces 50 percent less carbon monoxide in the smoke flue and in the room as compared to the dual-purpose coal heater, the content is even less when the fire is high. The amount of heat released indoors is higher than that of a honeycomb coal furnace and is close to that of a briquet coal burner. It saves 33 percent of the coal. The fire starts fast and the burning time of a banked fire is long; a lump of coal can be banked for as long as 24 hours. It keeps the room ash-free, clean, and sanitary, since a small drawer installed at the opening of the heater collects the ashes and can be removed for dumping. It has a pleasing and esthetic appearance--it looks similar to a small nightstand, and its exterior is painted with various colors of fire-resisting cured paint.

At the present time, because the heater is still being handmade, they are sold at a relatively high price of 35 yuan. With mechanized mass production, the price can be reduced to 10 yuan per unit. These new heaters can be bought at the Tiantan exhibition.

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Taiyuan Coal Gasification

Taiyuan SHANXI RIBAO in Chinese 21 Aug 81 p 1

[Article by Zhan Fuquo [2069 1381 0948], Zhou Enying [0719 1869 5391] and Gong Qui [7895 6311]: "Coal Gasification Stressed in Taiyuan"]

[Text] The first meeting of the board of directors of the Taiyuan Coal Gasification Company, jointly administered by the Ministry of Coal Industry and the Shanxi Province people's government, was recently held in Taiyuan; at the meeting, the code of the Taiyuan Coal Gasification Company was passed and matters regarding the earliest possible accomplishment of coal gasification in Taiyuan were investigated together.

In late April 1981, based on directives from the Communist Party Central Committee and leading comrades of the State Council, the State Council approved the joint administration of the Taiyuan Coal Gasification Company by the Ministry of Coal Industry and the Shanxi Province people's government. On 18 and 19 August, the board of directors of the Taiyuan Coal Gasification Company held its first general meeting. Present at the meeting were chairman of the board Yue Weifan [1471 4850 5672] (deputy governor of Shanxi Province), first vice chairman Kong Xun [1313 8113] (deputy minister in the Ministry of Coal Industry), vice chairmen Jiao Zhijie [3542 1807 2638] (deputy director of the Shanxi Province Planning Committee), Yang Zhan [2799 1455] (director of the local bureau of the Ministry of Coal Industry), and Gao Yacai "7559 0068 2624] (director of the Shanxi Province Coal Management Bureau), and board members Zhang Mingli [1728 2494 3810] (chief of the Planning Department of the Ministry of Coal Industry), Wu Jing [0702 0079] (deputy director-general of the Chinese Energy Resource Research Commission and vice chairman of the Technical Committee of the Ministry of Coal Industry), Liu Congzhou [0491 1783 0719] (deputy director of the Shanxi Province Urban Construction Bureau), Cheng Jianfu [2052 1696 4099] (deputy director of the Shanxi Province Chemical Bureau),

Shen Zhong [3088 6850] (vice chairman of the Taiyuan Municipal Revolutionary Committee) and Bai Kai [4101 0418] (director of the Taiyuan Municipal Metallurgy Coal Industry Bureau). Board members Jia Songming [6328 1529 2494] (deputy director of the Planning Institute of the Ministry of Coal Industry) and Wang Zeren [3769 3419 0088] (deputy chief of the Finance Department of the Ministry of Coal Industry) were absent because of other businesses.

After thorough deliberation, the company code of the Taiyuan Coal Gasification Company was passed at the general meeting of the board of directors.

Governor Luo Guibo [5012 6311 3134] of Shanxi Province attended and addressed the meeting. He emphasized that coal gasification is a major event to which the vast ranks of people of Taiyuan municipality have looked forward for many years. In the past this wish was not realized for various reasons, and the people of Taiyuan have opinions about this. In last year's government work report presented at the provincial people's congress, the question of the coal gasification of Taiyuan was specifically mentioned. The party Central Committee and the Sate Council are deeply concerned about, and support, the coal gasification of Taiyuan and directed the Ministry of Coal Industry and the Shanxi Province people's government to manage the project jointly. With strong support from the party Central Committee and the State Council and with the collaboration of the Ministry of Coal Industry, we are determined and confident that this beneficial endeavor will be accomplished as soon as possible.

During the meeting, comrades attending the board meeting also visited and inspected the Taiyuan coal gasification plant construction. They all indicated that they would work toward the realization of coal gasification in Taiyuan with the greatest determination, adopt the optimum proposal and actively overcome the difficulties.

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Shibaogou Mining Method Improvements

Taiyuan SHANXI RIBAO in Chinese 25 Jul 81 p 2

[Article by Wang Xianbin [3769 2009 2430] and Ren Fuxing [0117 1788 5881]: "Shibaogou Mine Improves Mining Method, Extends Mine Life and Increases Recovery Percentage"]

[Text] "The precious coal resources are not regenerative. We will be committing a crime against the nation and later generations if we do not improve the old mining method." These words were spoken to the reporter by party committee secretary Li Hua [2621 5478] of the Shibaogou coal mine in Xinxian Prefecture. Since June 1980, the Shibaogou mine has improved the old mining method, raised the coal recovery percentage and extended the life of mine shafts that are almost exhausted.

The Shibaogou coal mine was developed from small coal pits. In the past, using the old mining method, the waste of coal resources was serious and the life of the mines was shortened. With backward mining methods, the amount of ineffective footage was high, which in turn caused problems between recovery and digging and often led to the passive situation of stopping the recovery while waiting for the digging.

After the Third Plenum of the 11th Party Central Committee, the Shibaogou coal mine party committee held a number of meetings and urged the workers and cadres to obtain detailed data on two items. The first item was the loss of resources. From 1953 to 1979, the resource recovery rate of Shibaogou mine remained in the 20-percent range, that is, 4 tons of coal were wasted for each ton of coal recovered. The second item was the number of years of service of the coal mines. Robbing in the past shortened the mine life by 30 years. If the old method of mining to the stumps had been continued for another 15 years, nothing would have been left. If the national requirement of 75-percent recovery can be reached by improving the mining methods, the mine life will be extended for another 50 years. By going through and comparing the figures in detail, all the cadres and workers deeply realized that mining method improvement was urgent and imminent. This was reassuring to people.

After their understanding was improved, workers at Shibaogou mine first made material preparations and organized learning and training at nearby mines for 20 key members of the technical staff. With the enthusiastic support of peer units, it took only 1 month for them to grasp the basic operation procedures of the various steps in long wall substrate mining using a metal screen false ceiling. Test mining was subsequently conducted. Today, the three principal coal seams, numbers 2, 3 and 5, are all using the regular long wall mining method with the aid of metallic props. The recovery percentage from January to May 1981 reached 69.2 percent, a 39.6-percent increase over the same period last year. The long wall mining surface also eliminated accidental death in the past year.

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Jincheng Mining Bureau Achievements

Taiyuan SHANXI RIBAO in Chinese 5 Aug 81 p 1

[Article by Zhang Qiyuan [1728 0796 0626]: "Jincheng Mining Bureau Now Ranks Among Country's Best"]

[Text] After putting the distribution according to work policy on a solid basis, deploying a variety of economic responsibility systems and making a great effort for mechanized mining, the Jincheng Mining Bureau, an important base of smokeless coal production of China, achieved an all-personnel efficiency of 1.781 tons and 87.49 percent of mechanized mining in the first 6 months of 1981, equalling or surpassing the advanced level of coal mines in the country. In the first half of 1981, the raw coal output of Jincheng Mining Bureau exceeded the national quota by 200,000 tons, 41.3 percent of the mining at the bureau was mechanized, 64.1 percent of the contract profit payments to the nation for the entire year 1981 have already been made, and advance footage overfulfills the national quota by 1,800 meters.

In 1981, party organizations of Jincheng Mining Bureau at various levels put the distribution according to work policy on a solid basis, established a number of economic responsibility systems and a cadre assignment responsibility system, and divided the eight national economic and technical targets into some 30 subtargets

and assigned them to the staff and workers. In the meantime, they also made further improvements in the piecework system. Indicators such as material consumption and engineering quality were made part of the evaluation of mining tasks according to piecework on the first line. In addition, national and labor contract systems were implemented in auxiliary units. Various units also took active measures to control overtime and nonproductive labor and obtained noticeable results. In the first 5 months of 1981, the bureau's nonproductive labor decreased by 53.6 percent and overtime labor decreased 21.9 percent as compared to the same period in 1980. The work time utilization rate of the first-line miners generally improved by about 1 hour over last year. From January to May, the bureau saved a total of 379,000 yuan in material costs and reduced the cost per ton of coal to 0.5 yuan below the national target. In the first 6 months of 1981, the consumption of mine shaft lumber in the bureau decreased by 35.31 cubic meters per million tons over the same period of last year and set the best record of the bureau. The accidental death rate per million tons of coal decreased 0.9 percent, and major and minor injury incidents decreased 28.27 percent and 17.3 percent respectively as compared to the same period of 1980.

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Commune, Brigade Production Cooperation

Taiyuan SHANXI RIBAO in Chinese 21 Aug 81 p 1

[Article by Rong Changqian [2051 2490 6197] and Jia Yanming [6328 3508 2494]: "Commune and Brigade Coal Mines Continue To Increase Production"]

[Text] In 1981, the commune and brigade coal mines in Shanxi insisted on the policy of unified planning, rational layout, reorganization and progressive improvement, and the production got better every month. On the basis of a 32-percent production increase last year over that of the year before, a new record has been set. As of the end of July, the commune and brigade coal mines in Shanxi have produced 19.867 million tons of raw coal and completed 65 percent of the year's quota, an increase of 22 percent over the same period last year.

Shanxi has a rich resource and a complete variety of coal. The geological conditions are good and the coal is easy to mine. The vast population of peasants are historically used to mining coal and the nation's four modernizations are in urgent need of coal. Since the Third Plenum of the 11th Party Central Committee, the rural communes and brigades in Shanxi Province have done well regarding food production and at the same time they have also made great efforts in constructing commune and brigade coal mines. But due to the improper "leftist" influence, the development of commune and brigade coal mines a few years ago was blind, the layout was irrational, the safety conditions were poor, the workers were accident prone and the recovery rate of resources was low. In 1981, the management branches of the various levels of commune and brigade enterprises in Shanxi Province stand out for grasping the readjustment of commune and brigade coal mines. Safety reorganizations are continuously being made, technical revisions are carried out in a planned and organized fashion; the number of wells has been reduced and mines are operated jointly, more than 500 coal mines in Shanxi Province are now run jointly by commune and commune, brigade and commune, commune and brigade, county

and commune, and military and civilian. Such jointly operated coal mines acquired advantages in all aspects: the scale of mining is suitably increased, the ability to prevent accidents is strengthened, technical training is provided, mining methods are improved, the resource recovery rate is improved and all this makes the development of commune and brigade coal mines healthy during the readjustment. In 1981, a total of 183 mines are being improved, out of which 139 have completed the improvements. The commune and brigade coal mines in Shanxi Province have also conducted 5,000 man-sessions of technical training and upgraded production and reduced accidents.

Another direct reason for the good prospects of commune and brigade coal mines in Shanxi is the deployment of the economic responsibility system, which enlarged the autonomous rights of the enterprise, improved the profit-sharing scheme, gave more benefits to the producing commune and brigade, and motivated the activeness of the producers. A number of coal mines at various locations have signed production contracts with the commune, and the mines pay the workers according to a graded progressive computation. The expenses are on a fixed quota and the savings can be kept by the worker. This has vigorously promoted production, and the cost per ton has had a pronounced decrease.

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Shanxi's Coal Exports

Taiyuan SHANXI RIBAO in Chinese 9 Sep 81 p 1

[Article by Liu Xiangdong [0491 0686 2639] and Liu Fugui [0491 1381 6311]: "Shanxi Exported 350,000 tons of Coal in the First 7 Months; Manifesting Superiority and Earning Foreign Exchange"]

[Text] Shanxi's local coal exporting company, taking powerful measures and using every available means, has quickened the export of local coal. In the first 7 months this year alone, 350,000 tons of coal have been shipped to ports, then on to various parts of the world.

Coal exports from Shanxi used to be managed by the China National Hardware and Minerals Import and Export Corporation, and coal production was dictated by the unified national plan. Last year, establishment of a local coal exporting company was approved by the concerned national government department. This company is to manage exclusively the export of local coal.

After this company was established, the state invested 4 million yuan for the construction of a coal storage site more than 55,000 square meters in area at Qinhuangdao harbor. With assistance from the provincial economic commission and the provincial coal management bureau, this company carried out a general survey of the coal resources, the production capacity and the coal quality of a number of mines including Yanbei, Datong, Jinzhong, Luliang and Linfen. Based on the survey data, a number of export coal mine points were selected and those export coal mines which lacked some necessary production equipment such as coal crushers and coal selectors were provided with investments and loans in time to solve the

problems. As a result, the quality of export coal was guaranteed and the export rate was increased. According to the statistics, over a period from July last year to July this year, a total of 640,000 tons of local coal have been moved to the port storage site and more than 410,000 tons have been shipped abroad, earning foreign exchange amounting to US $17.92 million and a pure profit of more than 26.34 million yuan. It has not only increased China's financial income but also contributed significantly to the four modernizations.

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Shanxi Statistics Reported

Taiyuan SHANXI RIBAO in Chinese 21 Sep 81 p 1

[Letter from Ren Binghang [0117 4426 0474], Liu Yongquan [0491 3057 3123], and Ji Zhongshi [0370 0022 2514] of the Shanxi Provincial Bureau of Coal Management: "Statistics of Coal Output in Shanxi's Major Bureaus of Mines in the First Seven Months of 1981"]

[Text] Comrade editor:

Currently there are 70 integrated mining facilities in Shanxi Province. In the first seven months of 1981, Shanxi's coal output has reached 11.78 million tons, which amount to 38 percent of the total extraction of the seven large unified distribution coal mines. Among the mining bureaus in Shanxi, Datong and Yangquan have approached the 50 percent level of integrated mechanized mining of coal. Of key importance in improving the coal output of Shanxi are the sound management and usage of mining facilities and the effort to boost the output of individual mining teams. With this in mind, we now provide you with production data of the large mining bureaus in Shanxi for the first seven months of 1981 and hope you will publish them so that various units can learn from each other and work together to improve coal production.

Comparison of coal outputs at major mining bureaus
in the first seven months of 1981

Project Unit:	Datong	Yangquan	Xishan	Fenxi	Luan	Jincheng
Unit production (tons)	33770	39914	38326	40506	41225	39025
Miner efficiency (tons)	13.697	16.049	18.175	10.86	17.891	14.77

Overall, the production status of integrated mining in Shanxi in 1981 is good. In the first seven months, the average output of integrated mining teams has reached 36,475 tons --- 2,074 tons higher than the output of the same period last year --- and the individual miner efficiency is 14.86 tons, an improvement of 1.06 tons over the same period last year. However, there also exist a number of problems. To name the major ones, coal surface is improperly laid out in some integrated mining teams, equipment is poorly matched, excessive time is spent on moving, there is poor management and equipment repair, mechanical and electrical accidents and

injuries and casualties still occur from time to time, and in certain teams, fighting for equipment still exists. The development of integrated mining is very unbalanced; for example, team No 4 of the Yongdingzhuang mine of the Datong mining bureau, which has the best production record, produced a total of 75,000 tons of raw coal in the first seven months of the year whereas the poorest team had an output less than 10,000 tons. Today there are still ten low output integrated mining teams; if their unit production can be improved to the average level, the raw coal output of Shanxi will be increased by 20,000 tons per month. We hope all the production units will look at these records and compare to see whose efficiency is high and who makes greater contributions. In the comparison, find out how far they are falling behind, learn from the good performers, develop the full force of integrated mining facility and improve the coal output as quickly as possible to support the modernization construction of the socialist society.

Editor's reply

In 1981, the increase of coal production in Shanxi Province has been slow and advances are limited. One prominent problem is the decrease of unit production and unit advance at the coal surface. Causes for the decrease can be attributed to low show-up rate, low work hours and under utilization of machines. If the coal production is to be improved, great efforts must be made to shape up the organization and discipline of the labor force, improve all personnel efficiency and per unit production and footage figures. In the letter written by Comrades Ren Binggang et al, integrated mining outputs of the large unified distribution coal mines in Shanxi Province are compared. We hope that, in comparing these results, all the production units will catch up by learning from the advanced units and improve the unit production at the coal surface in order to boost coal output as quickly as possible.

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Shanxi Increased Output Continues

Taiyuan SHANXI RIBAO in Chinese 3 Oct 81 p 1

[Article by Wang Zhenhua [3769 2182 5478]: "Shanxi Continues To Increase Coal Output During Readjustment"]

[Text] Holding fast to the route of developing potential, restructuring and improvement, local coal mines in Shanxi Province have strived to improve the integrated production ability of the mines. Raw coal output has had large scale increases from year to year and the outlook of the mines has undergone profound changes. These changes have manifested themselves in four areas:

I. Production ability has continued to improve and raw coal output has maintained a definite growth during the readjustment period.

Up to the present, local coal mines have completed the modification tasks for 42 pairs of mineshafts and the coal output has increasd from 4.37 million tons before the modification to 8.87 million tons, which is more than a 100 percent increase.

In 1979 and 1980, raw coal output of the local coal mines averaged an annual growth of 16.44 percent. In the first eight months of 1981, raw coal output increased by 14.28 percent as compared to the same period last year and the national quota was overfulfilled by 7.73 million tons. By the end of 1980, raw coal output of the local coal mines was up to 49.28 percent of the total coal output of Shanxi Province.

II. Accident-proofing ability has been noticeably improved and the number of incidents has continued to decline.

Since August 1980, the local coal mines have conducted consolidations strictly according to the 10 standards issued by the Provincial People's Government and have subsequently closed 841 small coal mines that lacked safe production conditions and were irrationally laid out. Among the local coal mines, 32.5 percent have eliminated one-eyed shafts, open-flame lighting, open-flame firing and natural ventilation. Coal mines threatened by natural disasters such as flooding and fire have been greatly reduced.

III. Mining methods have been greatly improved and the recovery rate of coal resources has also increased.

In 1979, the number of new coal surfaces in local state-operated coal mines was 22.1 percent of the total number of coal surfaces and the output from new coal surfaces has reached 48.21 percent of the total extraction figures. In 1980, the number of new coal surfaces was increased by another 10 percent as compared to 1979, and the output from new coal surfaces has reached 54.35 percent. Extraction recovery rate in 1980 was 3.6 percent higher than that in 1979 and, under the same conditions, an extra 3.56 million tons of coal were recovered for the nation. Outputs from metal framed coal surfaces and high quality coal surfaces have also had large scale increases.

IV. Twelve railways exclusive for coal transportation were built and the ability to ship coal was improved.

Over the past two years, local coal mines have built 12 railways with a total length of 80.5 kilometers and a coal shipping capacity of 6.6 million tons for the exclusive purpose of hauling coal. In addition, 10 more coal transporting railroads with a total length of 114.1 kilometers are under construction. Up to now, local coal mines of Shanxi Province (including 6 state-operated unified-distribution mines) are in possession of 43 exclusive coal-hauling railroads with a total length of 301 kilometers and an exporting capacity of 24 million tons. In 1980, coal shipped from local coal mines to other provinces has reached 27.86 percent of the total amount of coal shipped out of Shanxi Province.

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CSO: 4006/53

Datong Bureau Exceeds Quota

Taiyuan SHANXI RIBAO in Chinese 3 Oct 81 p 1

[Article by Ma Yuxiang [7456 3768 4382] and Liu Fanli [0491 2753 7642]: "Datong Mining Bureau Completes September Assignment and Overfulfills Quota"]

[Text] With the courageous spirit of a Taishan climber, employees of the Datong Mining Bureau have worked hard to increase coal output. After overfulfilling the national quota for six consecutive months, the raw coal output of Datong Mining Bureau in September was 2.0395 million tons--again exceeding the national quota. Increases in extraction and enlargement footage have both exceeded quota.

For a period of time at the beginnning of 1981, raw coal output of Datong Mining Bureau fell below target. Various levels of leadership at the Bureau made serious analyses of the reasons for low output, initiated criticism and self-criticism, established the concept of overfulfilling the quota in 1981 and 1982, and strived to boost production. Since March 1981, as the result of a concerted effort by everyone in the Bureau, raw coal output has climbed steadily, overfulfillment of the quota was realized for 6 consecutive months, and most of the deficit in production near the beginning of the year was made up. In September, the Datong Mining Bureau kept up the spirit and established 10 concrete measures for increasing output by making good use of the forces at hand and developing further potential.

September is a very busy month in the Yanbei area since both the autumn harvest and the traditional "mid-autumn" festival fall in September. More than 100 leading cadres from the Bureau and the mines went deep into the brigades and the group units to strengthen political thoughts and to insure attendance. At Jinhuangong mine, with the "five initiatives"of party members, league members, model workers, brigade cadres and group leaders, the attendance rate of extraction and forward digging workers in September reached 75 percent, which insured the normal progress of production and led to an output 12,400 tons above quota. According to unofficial statistics, 4,710 workers at Datong Mining had made plans to return to their villages for the autumn harvest or for vacation; with proper arrangements, they have delayed their vacation and made new contributions in obtaining a good coal output.

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Duerping Mine Production Increases

Taiyuan SHANXI RIBAO in Chinese 7 Sep 81 p 1

[Article by Li Taixian [2621 1132 6513], Sun Huaiyu [1327 2037 1342] and Niu Gengtian "3662 5087 3944]: "By Strengthening the Political Work and Treating the Three Relationships Correctly Duerping Mine Strives for Speed Amidst Reorganization"]

[Text] Duerping mine of the Xishan Mine Bureau correctly treated the relationship between production and reorganization, insisting on good coal production during the reorganization, and made its coal yield increase season after season. In the 2 years of 1979 and 1980, the raw coal production increased on average more than 10 percent each year, realizing a profit which increased on average more than 80.1

percent a year. From January to July this year, the raw coal production increased 15.7 percent compared with that of the same period last year, and realized a profit which was 26.1 percent higher than that of the same period last year.

The reasons why Duerping mine was able to maintain a steady rate of expansion are as follows: They treated the relationship between production and reorganization correctly and strived for progress amidst reorganization and increased production amidst reorganization. In the beginning there were some misunderstandings among a number of cadres at the mine. They considered that reorganization meant retreat and to implement reorganization meant to hold down production. The party committee member of the mine, focusing on this misconception, instructed the staffs and workers and showed them how to treat the following relationships correctly: 1) Relationship between the local and the whole: The nation is urgently in need of coal. Coal production may only increase and may never decrease. Local considerations must give way to national ones, and internal reorganization of an enterprise must follow the reorganization of the national economy. 2) Relationship between production and reorganization: If local coal production is not increased, then the national income cannot be increased and neither the enterprise nor the workers will benefit much. The speed at which reorganization can be carried out will be adversely affected by all this. 3) The dividing line between a high standard and an advanced standard: We must oppose not only the unrealistically high standard but also exaggeration of difficulties. We must fight the pessimistic and conservative idea which prevents us from achieving increased production in spite of our capacity. Through education, the thoughts of workers as well as cadres were unified around correct concepts, so that the morale of all the employees of the mine was kept high throughout. Upon this foundation, they have conscientiously implemented the policy of distribution according to the labor and various other kinds of economic responsibility systems within the enterprise. They have aggressively pursued mechanized mining method and thus expanded their coal productivity considerably.

The experience of Duerping mine proved that maintaining a steady rate of increase of coal production not only did not adversely affect the rate of reorganization but, in fact, helped it. From 1979 till today, this mine has retained a portion of profits amounting to 3.04 million yuan, and renewal and remodeling funds amounting to 6.75 million yuan, thus completely eliminating the problem of a shortage of capital needed for the reorganization. Up until now, the entire mine has completely made up more than 6,300 meter footage advance shortfall, solved its disproportion problem in mining and, as a result, the excavation, preparation and recovery projects have all exceeded the standard set by the government. The projects related to the construction of fringe benefit facilities for the staffs and workers have cleared away more than 59,100 square meters of area, and the area on which work has begun is up to 40,000 square meters. The engineering projects related to the construction of ground storage, loading and transportation system have been completed. The engineering projects related to the construction of ventilation systems and safety measures are progressing rapidly, and these projects are expected to be finished ahead of schedule. Last year, the average income of the staff and workers also increased from 78.4 yuan a month in 1978 to 100 yuan a month.

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CSO: 4006/69

Fenghuangshan Output Up

Taiyuan SHANXI RIBAO in Chinese 7 Sep 81 p 1

[Article by Wang Qingping [3769 3237 1627] and Zhou Mingding [0719 2494 1353]: "Stirring Up the Revolutionary Spirit and Striving to Increase Coal Production, Fenghuangshan Mine's Raw Coal Production Increased Rapidly"]

[Text] The entire staff and workers of Fenghuangshan mine, under the Jincheng Mine Bureau and under the leadership of party committee members, have stirred up the revolutionary spirit and strived to increase coal production in order to support the national economic readjustment. The raw coal production of the entire mine doubled from 1977 to 1980. During the period from January to July this year, the state plan had been completed for all eight economic indicators, creating a historic high level for the period.

The party committee of Fenghuangshan mine believed that the work conditions at the mine field were full of hardship, and the only way to increase production is to stir up the spirit of sacrifice and perseverance. To do this, they have organized the ranks of staff and workers well, and have taught the workers and cadres the revolutionary philosophy of life, love for the mine, and dedication to the mine. They explained to the workers the important position occupied by the coal industry in the entire national economy, and the glorious responsibility that rests on the shoulders of the mine workers, filling the workers and cadres with a sense of responsibility and a spirit of sacrifice, so that strong combat spirit and high morale prevailed throughout the mine. In the first half of this year, more than 270 staff and workers were recognized as advanced producers and advanced workers.

The party committee of this mine has also paid attention to the education of party members and cadres so that they can lead effectively by setting good examples and models. The president of the mine, Wang Jiabin, and the vice-presidents in charge of production and safety insist on going down into the mine shafts and work sites in order to understand the situations there so that the problems may be solved more effectively. They are found in the mine shafts, more than 15 days each month. Following the examples set by the leading cadre, the communist party members of the mine are leading the masses day and night engaging in battles with a spirit comparable with that of scaling the Yuhuang summit of Taishan, willing to suffer first before enjoying the fruits of their labor.

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CSO: 4006/69

Xishan Mines Increase Output

Taiyuan SHANXI RIBAO in Chinese 25 Sep 81 p 1

[Article by Xu Ruoqi [1776 5387 3823]: "Three Projects in Xishan Mining Bureau Reach High Targets"]

[Text] Xishan Mining Bureau has achieved very good economic results in their efforts to increase output and reduce costs. From January to August, the cost per ton of coal mined in Xishan Bureau has decreased to 14.77 yuan, the lowest among

the unified-distribution coal mines in China; 52.39 million yuan of profit was achieved and 47.18 million yuan of contract payment was made to the State, the absolute values of the profits realized and the contract payments made have placed Xishan Mining Bureau second from the top among China's unified-distribution mines. This Bureau has also overfulfilled raw coal production quota by 440,000 tons, which is the second highest among the nation's unified-distribution coal mines.

In 1981, because of price increases in steel and lumber and other policy reasons, the cost per ton of coal at Xishan Mining Bureau would have been 1.71 yuan higher than that of 1980. Computations based on the raw coal production plan set by the State, there would be a 15.41 million yuan expense increase at Xishan mines. The Bureau's Party Committee explained the factual difficulties to the employees and mobilized the work force in a great effort to develop the potential within the enterprise, worked hard to increase output, conserve resources and lower costs. Since May, they have initiated an enterprise consolidation which consists of examining the system, the leadership, the discipline and the weaknesses and improving the economy in the enterprise and they have improved the management. This has led to an accumulated costs per ton of coal for the first 6 months of 1981 lower than the target by 0.09 yuan and insured the completion of contract payments.

In consolidating the enterprise, the Xishan Mining Bureau seriously promoted a variety of economic responsibility systems and made clear-cut regulations concerning the jurisdiction, economic responsibility, contract, method of computation, usage of funds and award payments for the bureau and mines (plants and offices). They have placed the targets of increasing revenue and cutting costs solidly on the basis of wards, teams and individual workers and linked them up with the employee's income to motivate the worker's initiativeness. From January to August, 1.74 million yuan were saved at Xishan Mining Bureau just from the savings on mine lumber, metal props and explosives alone. The total value of increased income and reduced costs has reached 19.57 million yuan, which is equivalent to an average of 3.02 yuan for each ton of coal mined.

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Briefs

FIVE PROVINCES' COAL MEETING--The Ministry of Coal Industry recently held a report meeting at (Baisha) Mining Bureau in Hunan Province on the readjustment of the relationship between extraction and tunneling in five provinces, namely: Guizhou, Henan, Anhui, Jiangxi and Hunan. The meeting stressed that to step up coal production, it is essential to attach importance to tunneling work. The meeting pointed out that to fulfill coal production quotas, many coal mines concentrate on coal extraction and disregard tunneling work in November and December every year, resulting in imbalance between extraction and tunneling. The meeting demanded that this situation be resolutely changed, that importance be attached to tunneling and that the relationship between extraction and tunneling be readjusted well. [Changsha Hunan Provincial Service in Mandarin 1100 GMT 7 Nov 81 HK]

GUANGXI COAL PRODUCTION--Guangxi Region's output of coal in September was some 100,000 tons more than in August representing an increase of 28.67 percent; and its tunneling progress was 25.46 percent greater than in August. [Nanning Guangxi Regional Service in Mandarin 1100 GMT 19 Oct 81 HK]

JIANGSU COAL MEETING--A Jiangsu provincial work conference on local coal mines was held in Xuzhou from 29 October to 1 November. Since 1969 a large number of locally operated coal mines have been established in the province. As of the end of 1980 these local coal mines had produced a total of more than 35 million tons of coal in 10 years. The conference called for efforts to maintain the annual output of the local coal mines above the 4 million-ton level. [Nanjing Jiangsu Provincial Service in Mandarin 1100 GMT 6 Nov 81 OW]

JILIN COAL PRODUCTION--In the January-September period, collieries across Jilin Province whose products are distributed under a unified state plan overfulfilled the raw coal production plan by 361,780 tons and the tunneling footage plan by 4,000 meters. The death rate declined by 6.4 percent from the same 1980 period. The rate of ash composition and gangue composition of commodity coal decreased by 74 per thousand and 26 per thousand respectively compared with the corresponding 1980 period, increasing 3.82 million yuan of income for the state. [Changchun Jilin Provincial Service in Mandarin 1100 GMT 6 Oct 81 SK]

SHANXI COAL PRODUCTION--According to the statistics of the Shanxi Provincial Management Bureau of coal mines, as of 21 October, the local coal mines had overfulfilled the year's production quota of 51.31 million tons. This was 71 days ahead of schedule. As of the end of October, the coal mines had overfulfilled the year's production quota by 2,040,700 tons. From January to October, the total production of coal increased by 13.11 percent over the corresponding period last year. In the wake of increasing production, the coal mines in the province have also attached importance to production safety. From January to September, the province exported a total amount of 21,057,400 tons of coal to other provinces and regions throughout the country, an increase of 40.77 percent over the corresponding period last year. In order to make arrangements for next year's production, the provincial coal mines management bureau held a work conference in Shouyang County in mid-October. [Taiyuan Shanxi Provincial Service in Mandarin 2300 GMT 5 Nov 81 HK]

CSO: 4006/130

OIL, GAS EXPLORATION CONTINUES; PROSPECTS GROWING

Pearl River Estuary Basin Reserves

Guangzhou YANGCHENG WANBAO in Chinese 12 Aug 81 p 1

[Article by Gong Zhijin [7895 1807 3866] and Liu We'kun [0491 3634 0981]: "Pearl River Basin Is Now Nation's Largest Oilfield"]

[Text] "The Pearl River Estuary Basin, 200 kilometers from Guangzhou municipality, has now been confirmed as China's largest oilfield among the oil reserves already explored. This is the latest news released by Chinese geologists in their recently completed "Oil and gas prospects evaluation report for South China Sea-Pearl River Estuary Basin." It is the result of the hard work of 1,700 South China Sea ocean geology workers.

On 8 August, geologist Dr Jin Qinghuan [6855 1987 3562], principal technical administrator of the South China Sea Geological Survey Command, met with reporters and gave a detailed account of the Pearl River Basin and their efforts of the past 5 years in uncovering the facts.

Ample geophysical survey and ocean drilling data indicate that the Pearl River Basin is a large oilfield with abundant oil and gas reserves. Its geological conditions for oil formation are superior. First of all, the basin has a large area--150,000 square kilometers--and it is one of China's largest basins south of Qinling. The basin has thick sedimentation, ranging from 7,500 to 11,000 meters at the center of the basin. By comparison, the sedimentation layers of the familiar Sanshui Basin and the Maoming Basin in Guangdong Province are generally 3,000 to 4,000 meters thick. The thick sedimentation layer of the Pearl River Basin implies there are many oil-bearing layers. Moreover, there are abundant regional structures properly distributed in the basin. The major regional structures number about 200. These anticline structures are like a bunch of huge oil storage tanks buried deep in the ocean.

The members of the South China Sea Geological Survey Command began geological exploration in the South China Sea in 1975, and in 1976 they discovered the Pearl River Basin. From 1977 on, they explored the northern slope of the basin using the imported "Explorer II" ocean drilling rig. In 5 years, they have completed 48,870 kilometers of geophysical survey, including seismic, gravitational, magnetic and depth measurements. Seven wells were drilled, with a total footage advance of

17,275 meters; among them Pearl No 5 produced high-yield industrial oil. Early this year, the South China Sea Geological Survey Command organized technical personnel, and using the latest technologies including mass spectroscopy, stable isotope, and ultramicropalaeontology, conducted an integrated study of the survey results collected at the Pearl River Basin in the past few years. After a 6-month effort, they have completed the evaluation of oil and gas prospects of the basin.

Jin Qinghuan told reporters that the command's evaluation of the oil and gas reserves of the Pearl River Basin is conservative. Its evaluation is comparable to the calculations of some foreign oil companies and it reached essentially the same conclusions. This evaluation was conducted by the Chinese totally independently and it took only a little over 5 years. One must say the speed is fast. This is sufficient proof that the Chinese petroleum geology technical people are not only capable of finding large oilfields on land, such as Daqing and Renqiu, but are also of the even more difficult task of locating large oilfields in the depth of the ocean.

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Pearl River Basin 'Encouraging'

Guangzhou NANFANG RIBAO in Chinese 13 Aug 81 p 1

[Article by Liu Weikun [0491 3634 1024] and Wang Dekuan [3769 1795 1401]: "Oil and Gas Prospects in South China Sea-Pearl River Estuary Basin Are Encouraging"]

[Text] After a 5-year effort by the South China Sea Geological Survey Command of the Ministry of Geology, a large oil-bearing basin was discovered in the north gulf of the South China Sea. NANFANG RIBAO reporters interviewed geologist Dr Jin Qinghuan [6855 1987 3562] and other at the command and heard their encouraging scientific assessment: according to estimates based on the data, the basin's oil reserve prospects are better than those of the largest oilfields already explored in China today. This evaluation was made by the ocean geologists of the South China Sea Geological Survey Command entirely on their own.

The South China Sea is the largest sea in the proximity of China. Its total area is 3.5 million square kilometers, of which 1.96 million square kilometers belong to traditional Chinese sea territory. It has vast shelfs, slopes, lu long and deep sea plains and a series of benthic mountains, troughs and trenches. The complete geomorphology, varied sedimentation environment, and large flow of ground heat created favorable geological conditions for the formation of rica oil resources. Development of an ocean geological survey and the survey and exploration of ocean oil resources are highly significant to the development of China's economic construction.

The ocean geology work in the South China Sea has been going on for 20 years, but systematic investigation only began in the early 1970's. Since 1975, after the discovery of the north gulf basin, investigations were conducted in the Pearl River Estuary Basin only some 200 kilometers from Guangzhou. By the end of 1976, 150,000 square kilometers of the sedimentation area of the Pearl River Basin were defined.

Drilling was organized in 1977, and high-yield industrial oil flow was obtained in 1979. From survey to the flow of industrial oil, it took less than 5 years. This speed is exceptional even in foreign ocean oil geological survey and exploration.

In the last few years, the South China Sea Geological Survey Command has carried out an extensive general geology-geophysical investigation of the Pearl River Estuary Basin and drilled seven wells. In 1981 the command conducted an integrated study of the survey data obtained over the years and started compiling an "Oil and gas prospects evaluation report for South China Sea-Pearl River Estuary Basin," which is due for completion shortly. For the first time the report has made a scientific assessment of the oil and gas prospects: the basin has superior geological conditions; the thickness of sedimentation is great and there are abundant oil-bearing layers and locations; it has a high ground temperature gradient which is favorable for the transformation of organic matter into oil and gas; the contents of organic carbon, chloroform bitumen and hydrocarbons, all important in oil formation, far exceed the standard of oil-bearing rocks; the oil bearing structures have appropriate thickness, complete closure and proper distribution, the favorable oil bearing structures are like natural oil storage tanks buried extensively in the depth of the basin.

Based on the integrated study of the obtained data, the ocean geologists calculated the oil reserve prospects using a chloroform bitumen computation method. Calculation results indicate that oil reserve prospects in the basin exceed those of any of the large oilfields already explored in China.

The rich oil resources of the Pearl River Estuary Basin have attracted attention both here and abroad; quite a few foreign oil companies hurried here to negotiate on development and exploitation of the basin oil reserve. The assessment of the South China Sea-Pearl River Basin oil and gas prospects will play an important role in China's development of the South China Sea oil resources. It is the result of the hard work of the vast ranks of staff and workers of the South China Sea Geological Survey Command system. The exploration and development of oil in the Pearl River Basin will undoubtedly provide energy and capital for China's four modernizations construction; in particular, it will provide a strong material basis for four modernizations construction in Guangdong Province.

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CSO: 4006/495

Coastal Waters Basins

Beijing BEIJING RIBAO in Chinese 25 Sep 81 p 1

[Article by Li Weiyao [2621 1218 1031] and Huang Fengchu [7806 1144 0443]: "Six Big Oil and Gas Basins Found in Coastal Waters"]

[Text] China's ocean geologists have completed 1 million square kilometers of near-sea petroleum geological survey, discovered six large oil and gas basins and showed that the future prospects of China's oil and gas resources at sea are indeed bright.

The six large oil and gas basins are located at Bohai Basin, South Yellow Sea Basin, East China Sea Basin, and Pearl River Estuary Basin, North Gulf Basin and Yinggehai Basin at South China Sea.

Bohai territory is the first area where the Ministry of Geology conducted its geological survey of petroleum at sea. Ocean geology explorers discovered a 80,000 square kilometer depression in Bohai that is rich in oil and gas reserves. This depression is an extension of Shengli, Dagang and Liaohe oil fields in North China Basin toward the sea and is connected at the bottom of the ocean to the surrounding oil and gas bearing basins on land. Its total land and sea area is 180,000 square kilometers. The departments of petroleum industry have conducted detailed survey in this area and drilled a number of high yield oil and gas wells.

The South Yellow Sea depression is an extension of the north Jiangsu oil and gas bearing basin toward the bottom of the ocean, the land and the sea combined to form the North Jiangsu-South Yellow Sea Basin. The area of the ocean bottom portion alone is 78,000 square kilometers, there are more than 40 possible oil-bearing structures in the basin and the thickness of the oil producing rock layer is 5000 meters. Geology departments have drilled 8 holes in this area and discovered that the oil bearing rock system is similar to that of the north Jiangsu oil and gas basin.

The East China Sea Basin has the best prospects for oil at sea. Its area is 460,000 square kilometers, equal to the combined area of the Songliao Basin and the North China Basin. The basin can be divided into three sections: the western section, the middle section and the eastern section. The western section begins at 34° latitude in the north and ends at the Penghu Isles in the Taiwan strait in the south, stretching a length of 1,200 kilometers and an area of 260,000 square kilometers. The thickness of the sedimentary rock at the bottom is over 10,000 meters and 4 promising oil reserve structure belts were discovered. The "Eastern Zhejiang Long Wall" structure belt alone has an area of 5,000 square kilometers; it is an unprecedentedly large structure belt in China's history of petroleum geological surveying. The first oil survey well in East China Sea yielding multiple oil sand and high pressure natural gas was drilled on this structure belt in February, 1981.

The 150,000 square kilometer Pearl River Estuary Basin has a huge formation of third serial oil and gas bearing stratum. After extensive geological and geophysical drilling and survey, prospecting of oil and gas in the Pearl River Basin has now been completed.

China's petroleum geological survey at sea began in the late 1950's. At that time there were only 100 ocean geologists working primarily with fishing boats and apparatus for on-land oil surveing. Now China's ocean oil geological survey team has grown to more than 4,000 people equipped with some 30 survey vessels and advanced equipment for depth, earthquake, magnetic and gravitational measurements and sophisticated drilling platforms. The team conducts comprehensive geological survey of ocean bottom mineral resources, primarily oil, from close to the shore to deep sea areas.

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CSO: 4006/35

South China Sea, Southern Yellow Sea Prospects

Shanghai JIEFANG RIBAO in Chinese 22 Sep 81 p 1

[Article by Huang Fengchu [7806 1144 1443]: "Prospects for Extracting Oil and Gas at South China Sea and Southern Yellow Sea Are Excellent"]

[Text] The oil reserves in the South China Sea and Southern Yellow Sea are quite abundant and the prospects for extracting oil and gas are excellent. Oil and gas fields at sea with substantial yields are expected to be built. Chinese and foreign petroleum geology experts who participated in the geophysical exploration at sea are in agreement regarding this.

The Ministry of Petroleum Industry recently concluded its oil resource evaluation for eight geophysical exploration zones including the Pearl River Estuary Basin, Yinggehai, and the southern part of the North Gulf in the South China Sea and the Southern Yellow Sea. It has also been decided that cooperative oil exploration and development with foreign oil companies will be open for bids by the end of 1981 or at the beginning of 1982, at the latest.

The total area of the eight geophysical survey regions of the Pearl River Estuary Basin, Yinggehai and the Southern part of the North Gulf in the South China Sea and in the Southern Yellow Sea is 420,000 square kilometers. The Ministry of Geology and the Ministry of Petroleum Industry had conducted some geophysical exploration in the past in these sea areas and a number of exploratory wells yielding industrial oil and gas were drilled at North Gulf, the Pearl River Basin and Yinggehai. In 1979 China opened up cooperation with foreign companies and signed geophysical exploration agreements with foreign oil companies for these eight areas. A total of 48 oil companies from 13 different countries participated in this effort. The oil companies organized more than 700 technical staff in geology and geophysics and deployed sophisticated exploration equipment for this task. In over a year's time, they completed seismic testing for 110,000 kilometers and submitted to China 120 reports on the interpretation of geophysical exploration data and resource evaluation.

China organized more than 200 petroleum geology and geophysical exploration experts and technical personnel and, based on data submitted by the foreign oil companies, conducted a comprehensive analysis and study of the structure, oil reserve, oil yield and coverage conditions of these sea areas and estimated their oil reserve potentials. Extensive geophysical exploration data and drilling data indicate that these sea areas have broad distributions of deep sedimentation rocks and there are mature oil producing strata. More than 400 possible oil-bearing structures of various types were discovered in these regions and among them several dozen are major structures.

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CSO: 4006/31

South China Sea Oil Meeting

Hong Kong WEN WEI PO in Chinese 22 Oct 81 p 3 HK

[Report by WEN WEI PO correspondent: "Experts Submit Preliminary Reports in Guangzhou Probing into Prospects of Oil Fields in South China Sea"]

[Text] Over 170 top-level marine geologists came to Guangzhou to hold the first South China Sea geological symposium. At the symposium, they put forth data on geological surveys of the South China Sea continental shelf which have been carried out for many years and probed into questions concerning the geological features and oil and gas resources of the South China Sea.

At a time when the world is facing an energy crisis, promising results in prospecting China's offshore oil resources have already attracted the attention of oil circles at home and abroad.

At present, oil produced from offshore oil fields already accounts for one quarter of the world's total oil output. People are placing more and more hope on offshore oil reserves. China has a vast expanse of sea area of which the South China Sea occupies an important position. On 21 October, Ye Xuanping, vice governor of the Guangdong Provincial People's Government, extended his congratulations to the marine geologists who participated in the "South China Sea geological and oil and gas resources symposium" and said that the preliminary reports which revealed the secrets of this seabed treasury were "very inspiring."

In the 1960's, our country's marine geological scientific and technological workers carried out geological surveys in the Yingge waters of Hainan Island. In the 1970's, systematic surveys and prospecting work were carried out. In the first 4 years, geological and geophysical comprehensive surveys were carried out in Beibu Wan [Northern Gulf; Chinese name for Gulf of Tonkin]. As a result, a depression of 2,800 square kilometers was discovered in the middle of the Beibu Wan basin. The ministry of petroleum then carried out prospecting and industrial oil reserves were detected. After this, comprehensive geological and geophysical surveys were carried out over a vast area of 290,000 square kilometers east of the Leizhou peninsula and the Qiongzhou strait, west of Shantou and north of latitude 16 degrees 21 minutes north. The surveys included seismographical tests, marine magnetic surveys, aerial tests, seabed gravimetric tests, seabed structure sampling, geological cross-sectional surveys and drillings.

Data of surveys which have been carried out show that the geological conditions in the South China Sea are very favorable for oil and gas and there are rich resources of oil and gas there. Up till now, we have already discovered six large deposit basins in our country's sea area and three of them are in the South China Sea. This large seabed oil treasury of the South China Sea is extremely worthy of exploitation and development. At present, China is striving to expedite the prospecting, exploiting and developing of oil and gas resources in the South China Sea's continental shelf.

At the "South China Sea geological and oil and gas resources symposium" jointly held in Guangzhou on 22 October by the special Marine Geology Committee of the

Chinese Society of Oceanography, the Chinese Society of Marine Geology, the Chinese Society of Geology, the Ministry of Geology's South China Sea Survey Command, experts, professors, senior engineers and technological personnel with rich experience from 50 units concerned--the Ministry of Geology, the Ministry of Petroleum Industry, the State Oceanography Bureau of the Chinese Academy of Sciences, the Ministry of Metallurgical Industry, the State Seismological Bureau, universities and colleges--put forth, on the basis of results of geological surveys and scientific investigations which have been carried out over the past few years, over 50 academic papers on the South China Sea's oil-bearing and gas-bearing seabed structure and basin, the formation and changes of basin, the structure of oil reserves, the oil-bearing features of mesozoic strata and prospects of oil and gas resources in order to exchange views and to probe into questions of the South China Sea's geological features and resources. Professor Ye Zhizheng, member of the Earth Science Division of the CAS, vice president of the Chinese Marine Geology in our country has a very short history but it is developing quickly. Offshore drilling was started not long ago either, but gratifying results have been achieved. This gathering of outstanding geologists will certainly raise the level of our country's marine geological science and technology and push forward the exploitation and development of the oil resources in the South China Sea continental shelf.

Also participating in the meeting were Zhu Xia, member of the Earth Science Division of the CAS, director of the Geological Institute of the Geological Division of the CAS and a well-known geologist, Guo Lingzhi, Nanjing University's structure expert, and other top-level Chinese geologists.

CSO: 4006/71

Daqing Associated Gas Recovery

Beijing GUANGMING RIBAO in Chinese 27 Oct 81 p 2

[Article: "Daqing Oil Field Associated Gas Successfully Pressurized and Collected"]

[Text] Using Chinese-made compressors, Daqing Oil Field has recently succeeded in pressurizing and collecting associated gas and provided an effective means for improving collection and transportation technology and for conservative energy.

Oil field associated gas is a valuable chemical resource and fuel, about 6 billion cubic meters of associated gas are produced every year in various oil fields in China. In the past, due to the scattered gas sources and the low pressure, and due to the lack of suitable compressing equipments and associated facilities, it was difficult to collect and utilize the associated gas and most of this resource was not recovered and properly used. To correct this situation, Daqing began its experimentation of associated gas compression and recovery. Using its compression and collection facility, Daqing collected a total of 3.8 million cubic meters of associated gas. After subtracting the losses, this is equivalent to a recovery of 3600 tons of crude oil and the amount of energy used in the recovery is only about 6 percent of the energy recovered. Tests show that the Daqing compressing and collecting system is simple in structure, easy to maintain and can be promoted to wider use.

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CSO: 4006/74

Remote Sensing Reveals Fossil Fuel Deposits

Beijing XINHUA in English 0243 GMT 3 Nov 81 OW

[Text] Beijing, November 3 (XINHUA)--Chinese scientists have completed a large-scale regional geological survey in Sichuan basin by applying remote sensing techniques and got a wealth of stratigraphic, structural and mineral data.

XINHUA learned this today from He Shangrong, engineer of the Sichuan Geological Bureau, who is here attending the current second Asian conference on remote sensing.

He said the results obtained have deepened geologic research and improved the quality of mapping. Chinese scientists have accumulated significant data for predictions of some mineral deposits by means of remote sensing images and synthetic interpretations.

He said the coal-bearing beds in the Chong-Qing and Guangan areas which appear on the remote sensing image in clear light stripes have been proved to be coal-producing areas.

The ring structures in the area are favorable guides for finding oil, natural gas and salt, he said. There are good prospects for finding salt deposits. "The anticline should be an important area for exploration," he said.

In central and northwest Sichuan there are closed arch structures which provide important hints for searching oil and gas, the engineer said. In the east Sichuan foldbelt, coal- and iron-bearing beds mostly lie in the core of the anticlines. Several such deposits near Chongqing have been verified by drilling.

He said the depositional environments of the depression in front of the Longmenshan in the western fringe of the basin are very important areas for exploration of salt, glauber salt and other deposits.

CSO: 4020/26

New Petrochemical Technologies

Beijing GUANGMING RIBAO in Chinese 23 Aug 81 p 2

[Article by Shi Hua [4258 5478]: "Petrochemical Institute Develops New Fossil Fuel Technologies"]

[Text] The Petrochemical Institute of the Ministry of Petroleum Industry has obtained three major scientific research achievements in recent years in its development of energy conservation and mazut processing. Pronounced economic effects have been obtained after these research results have been promoted and employed in industrial production.

In 1977 the institute began a research project on a carbon monoxide catalytic combustion supporter. After 1 year, five types of combustion supporter were successfully developed in the laboratory. In 1979, in collaboration with the Yumen

refinery, the institute conducted industrial tests on a 12-ton scale catalytic cracking device which were successful in the first run. By the end of 1980, 19 refineries were already using the new technique. Two years' application has shown that the new technique using a carbon monoxide combustion supporter decreases the carbon monoxide content in the flue gas exhausted from the regenerator from 8 percent to less than 1 percent and greatly reduces the pollution of the atmosphere. The method allows heat to be recovered and decreases the energy consumption by 100,000 kilocalories for each ton of catalytic input. The method also improves the collection percentage of gasoline and light diesel fuel; on average the increase is 2 to 4 percent for light fuel oil. Preliminary estimates show that the 19 refineries using this new technique produce 200,000 to 400,000 tons more gasoline and diesel fuel for the country each year and burn 100,000 tons of fuel less, with a total economic benefit of more than 50 million yuan.

In addition, in 1980 the technique of mixing and refining mazut in the catalytic cracking process developed by the institute was proved successful in industrial tests conducted at the Modanjiang refinery. This new technique increased the collection percentage at the refinery by 9.2 percent, for a net profit of 4.78 million yuan in 1 year. This technique is also beginning to be used by refineries where the catalytic input is insufficient, and the economic benefits will be even more pronounced, especially at large plants. In 1979, the technique of residue solvent de-bitumen process and catalytic cracking were successful in tests conducted at industrial facilities at Dalian Petroleum Plant No 7. Using the combined techniques, 31 tons of gasoline, 28 tons of light diesel fuel, 7 tons of liquefied gas and 25 tons of surface asphalt can be obtained from 100 tons of oil residue. The techniques have received the attention of relevant departments and refineries, and promotion activities are being organized.

9698
CSO: 4006/495

Briefs

ANNUAL OIL QUOTA PROGRESS--Beijing, 1 Oct (XINHUA)--China's oil industry produced 75,554,000 tons of crude oil in the first nine months this year, fulfilling 76 percent of its annual quota, announced the ministry of petroleum industry. During the third quarter, some of China's big oil and gas fields such as Karamay in Xinjiang, Dagang near Tianjin and the Sichuan oil and gas field were hit by windstorm, heavy rain or flood. The workers soon restored normal production with the assistance of local authorities and met the production targets for July to September. In some oil oil-producing areas, effective measures were adopted to raise recovery rate and prolong the period for stable daily production. [Beijing XINHUA in English 0155 GMT 1 Oct 81 OW]

CSO: 4020/21

DAQING OIL OUTPUT--The Daqing petroleum administrative bureau achieves good results in applying the overall planning method. The bureau's annual crude oil output has increased by 1.5 million dun, comprising one-seventieth of China's total annual crude oil output. [Beijing Domestic Service in Mandarin 1600 GMT 10 Nov 81 OW]

CSO: 4006/130

GOBI DESERT EXPLORATION--Chinese petroleum exploration is being carried out in the Gobi Desert in northwest China, regions of carbonate rocks in southwest China, east China for deep reservoirs and offshore areas, said Niu Yuquan, 46, a geophysicist of the China Petroleum Exploration Development Corporation at a joint meeting in Beijing of the Chinese Geophysical Society and the American Society of Exploration Geophysicists. The offshore regions include the Bohai Bay, Yellow Sea, East China Sea and South China Sea. Chinese geophysicists in the last three decades have adopted various seismic methods according to the geological conditions of each oil bearing basin and achieved good results, Niu said. The Gobi Desert and loess high-lands in northwest China, the regions crisscrossed by water in northern Jiangsu Province and in Jianghan Plain, the mountainous districts and karst limestone zones in the southwest and the basalt zones in Hainan Island and northern Jiangsu were very difficult areas for seismic work. Niu said. However, through long practice, the Chinese geophysicists have understood the seismic problems more clearly. Niu Yuquan said that China had begun to develop digital recording and data processing in the late 1960's and early 1970's. As a result, China had discovered a series of buried-hill oilfields, for example, the Renqiu oilfield in north China found in 1975. He said that China would try to combine seismic methods with other geophysical methods and improve field operations and data processing. [Hong Kong TA KUNG P'O in English 17-23 Sep 81 p 6]

CSO: 4020/9

POWER-HYDROPOWER GENERATION, SUPPLY IMPROVING

Overall Planning Advocated

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 7, 12 Jul 81 pp 4-6

[Article by He Gegao [0149 2706 7559]: "Overall Planning in the Development of Hydroelectric Power"]

[Text] Both coal and petroleum are now in short supply in our country, and the development of hydroelectric power has come to be recognized as an aspect of strategic energy policy in the development of the national economy. Leading comrades of the Central Committee accord full importance to the development of hydroelectric power, and have frequently declared that more should be done in this area, and Premier Zhao Ziyang has stated that the purpose of its development is to create prosperity for future generations. Hydroelectric power can provide cheap motive power and can perform the functions of peak load regulation, frequency regulation, phase regulation and reserve power in the electric power system, in addition to offering the benefits of flood prevention, irrigation and navigation. But hydroelectric power generally involves rather large investments and long construction times, as well as the problem of loss of the inundated territory, and accordingly, there has been some hesitation in drawing up long-term plans and organizing annual plans. Because hydroelectric power is a component of the electric power system and also a component of the comprehensive use of rivers and streams, planning for hydroelectric power should take account of the whole picture, including both the electric system and comprehensive utilization, should make comprehensive plans and draw up overall balances, take account of all of the economic benefits from hydroelectric power, and draft long-term, comprehensive plans to guide the organization of annual plans. Here we advance a few preliminary opinions on taking account of all relevant factors in hydroelectric power planning.

1. Taking Account of All Economic Benefits for the Power System as a Whole

The electric power system must supply electric power steadily, safely, flexibly and economically; this is possible only if hydroelectric and fossil-fueled power stations complement each other, and a power system relying on only one of these types would be impracticable. Because both hydroelectric and fossil-fired stations have characteristic advantages and disadvantages, only by integrating them closely together so as to exploit their advantages and make up for their shortcomings is it possible to obtain the best results. For example, fossil-fired power stations can only operate steadily if a supply of coal is guaranteed; they can be used for a large percentage of the time, and the more steadily they generate electricity the

more economical they are. But fossil-fired generating units start up slowly, requiring 2 or 3 hours from ignition to the beginning of power generation, and accordingly they are incapable of flexibly handing peak load adjustment and frequency adjustment in a system and providing a quickly-available emergency reserve. If fossil-fired power stations are made to take on these tasks, the starting and stopping of the generating units will decrease the proportion of time during which they are in operation, coal consumption per unit power output will increase, the life of the generating units will be shortened, and there will be more malfunctions, which is uneconomical and unsafe. According to statistics from the Northeast China Power Industry Management Office, a drop in the proportion of electricity generated by water power in the Northeastern power system forced the fossil-fired plants to make up a large proportion of the peak load; the average peak load adjustment by fossil-fired stations in 1979 was 800,000 kW, of which 600,000 kW was taken on by high-temperature, high-pressure units, and 20,000 kW by medium-temperature, medium-pressure units, with the result that some fossil-fired generating capacities remained unused, which limited utilization of fossil-fired stations' superior feature of being able to produce electricity as long as coal is available. According to preliminary statics, in 1979 there was a power production shortfall of 2.9 billion kWh. When fossil-fired stations were used to regulate peak load, coal consumption went up greatly; if the 800,000 kW peak load regulation had been shifted from fossil-fired stations to hydroelectric stations, coal consumption in the main power grid would have been decreased by an average of 7 g [per kWh], which could have resulted in the considerable saving of more than 20,000 tons of coal over the year. In addition, the ignition of coal-fired units requires ignition oil; a 1,000-kW unit generally requires 1-2 tons, a 5,000-kW unit about 5-6 tons, and a 10,000-kW unit about 20-30 tons. Accordingly, frequent stoppages of coal-fired power generating units is very uneconomical. The situation is different for hydroelectric stations: in general, the quantity of electricity generated by hydroelectric stations is affected by water availability, so that in dry seasons their capacities decrease considerably and they cannot meet the system's requirements steadily, but they are easy to switch on and off, generally requiring only 1 or 2 minutes, which makes them extremely flexible in peak load regulation, frequency regulation and response to sudden system failures. When hydroelectric stations are available to take on these tasks, fossil-fired stations can be kept in steady, economical operation, so that the entire system is in its optimal state. In addition, the generating units of the hydroelectric and fossil-fired power plants in an electrical system generally have to be overhauled in rotation, and we can make use of the high-water season, when hydroelectric power output is high, to overhaul fossil-fired units. Accordingly, the fact that hydroelectric power stations are in use for a smaller percentage of the time is not an essential shortcoming, but results from the fact that the entire system requires that they take on tasks which are difficult for fossil-fired power stations, so as to improve the overall operating state of the system. If we draw up a power balance for the entire system, we can find a suitable time percentage of utilization for hydroelectric stations and determine the proper time percentage of operation for each hydroelectric station within the overall inventory of hydroelectric stations. We should not say uncritically that the small percentage of time utilization of hydroelectric stations is a shortcoming, nor should we consider economy of operation only in terms of hydroelectric stations alone; instead, we should consider economy in terms of the entire system. Of course, we should also avoid uncritically increasing the generating capacities of hydroelectric power station equipment in order to decrease unit construction costs. In systems where

hydroelectric power accounts for a large share of the total generating capacity, the hydroelectric stations will have to take on a part, even a considerable part, of the base load. In the Southwestern part of our country, where water power is particularly abundant and the conditions for its development are rather good, and where rich deposits of nonferrous metals are also located, some hydroelectric power stations are built for the extraction and refining of nonferrous metals, so that the percentage of time during which they are in operation must be high.

To summarize, in an electrical power system, overall planning and comprehensive balancing must be conducted on the basis of load characteristics and the energy situation and in terms of system stability, safety, flexibility and economy so as to determine the suitable ratio between hydroelectric and fossil-fired stations. In areas with limited water power resources, where the hydroelectric stations primarily provide [storage] capacity, the percentage of hours in operation can be somewhat low, as in the Northeast and East China regions, where the requirement is only for about 2,000 to 3,000 hours of operation; the figure can be even lower for the North China area, and in the Beijing-Tianjin-Tangshan area the construction of pumped storage power stations, using excess fossil-fired electrical capacity during low-load periods to pump water to high-altitude reservoirs, releasing it at peak periods to generate power for load regulation, has even been suggested. In areas where water power is plentiful, such as parts of the Southwest and the upper reaches of the Yellow River, hydroelectric stations will account for more of the power generation capacity, hydroelectric equipment may account for more than half of the overall system, the utilization ratio for hydroelectric power may be 5,000 hours or even more. This requires that the entire electric power system be taken into consideration in drafting rational long-term plans so as to develop hydroelectric power in a planned and systematic manner and make suitable adjustments in the annual plans. We should avoid the past faulty situation in which "hydroelectric power was rational in the long-term plan but could not be organized into the annual plans," and when in fact there was no detailed, analytical long-term plan.

2. Overall Consideration of Expenditures and Receipts

In the past, when selecting a power generation program, whether the choice was between different types of hydroelectric power stations, between hydroelectric and fossil-fired stations, or between large-size or medium or small-size stations, emphasis was generally placed only on the investment per kilowatt or kilowatt-hour for the project, which was a quite inadequate approach; to know whether a project is economically rational, it is necessary to take expenditures and receipts into consideration, as described below.

A. When calculating the investment in electric power construction, we cannot take account solely of the investment in the station, but must also calculate the cost of various necessary projects associated with the station. When making comparisons between projects for hydroelectric and fossil-fired stations or when discussing the economic effect of a hydroelectric station in terms of its replacement of another station, in addition to calculating the investment in the construction of the station (including land acquisition, population resettlement, relocation of factory and mining enterprises and posts, telecommunications and transport routes and the like), it is also necessary to figure in the investment for transformer facilities, environmental protection and the like. In the past, when making comparisons

hydroelectric and fossil-fired power stations, fuel expenses were computed only when figuring the annual operating cost, and no account was taken of investment in the increased fuel storage area and fuels transport lines or roads required for fossil-fired stations; this is the method commonly used in Europe and the United States. Today many people believe that this method is irrational; this country differs from the European countries and the United States, since here the investments in power stations and associated construction are all provided by state finance departments, and if the capital construction costs for a fuel storage area and fuels transport lines or roads and other engineering are taken into account, this will enable the planning departments to choose between power generation plans by giving consideration to all the financial, material and resource aspects--especially since our country's current low fuel prices do not reflect the real social labor value.

When calculating investments, we must also take account of the fact that different proposals require engineering work of different duration. In the past, when calculating investment we took no account of interest, and thus ignored the fact that the investment was lying idle, with the result that we did not perceive the effect of the duration of construction on economic effect. Some large-scale projects with a long construction time and high investment were selected only because the investment per unit power output was low; conversely, some relatively small-scale projects with short construction times and low investments were rejected only because their investment per unit power output was high. If we were to compute the length of time the investment was lying idle and the recovery period, it is quite possible that at present, when this country's financial organizations are hard-pressed, more small-scale projects with a short construction time, low investment and rapid return would be selected and that limited investment funds would not be spent on huge projects which would give a return only in 10-odd or 20 years.

B. As everyone knows, hydroelectric stations do not consume fuel, and in-plant power consumption is only 1/40 that for a fossil-fired stations, in addition to which management expenditures are lower, so that operating expenses are always lower than for fossil-fired stations. However, if specific, detailed calculations are not made for every alternative plan, we will not understand the economic effects of investments, nor will be select the most rational project when choosing between different hydroelectric power stations or between hydroelectric and fossil-fired stations.

C. In comparing proposals for power construction projects, in addition to calculating investment and operating expenses we must also calculate economic results, and we must compare various power station proposals in terms of satisfaction of the requirements for a certain load level with or a certain load task (base load, intermediate load, peak load) with a given power system. When the alternative proposals include hydroelectric, fossil-fired and nuclear-powered stations, after a power or energy balance is drawn up for all of these alternatives on the same load curve, economic accounting is then carried out; it is necessary to calculate for each proposal not only the total investment in the power station and associated engineering (including interest on the investment) and operating expenses after the station goes into operation, but also the economic effect realized after the station goes into operation. If these expenditures and benefits are aggregated for a number

of years, using a state-specified time period, and tables or curves are drawn up, it will be possible to see clearly the difference between the expenditures and income for each proposed alternative year by year, the various investment recovery periods and the true economic effect, making it possible to select an economically rational proposal.

3. Taking Full Account of the Benefits from Comprehensive Utilization

Building hydroelectric stations changes the natural condition of rivers and streams and thus necessarily produces many contradictions. For example, when a dam is built, producing a reservoir, fields, towns, enterprises, transport lines, forests and the like upstream are inundated, a large population must be resettled, and the passage of boats, timber and fish may be hindered; on the other hand, a reservoir may make possible irrigation, flood prevention, improved navigation, aquatic products breeding, environmental improvement and other important benefits. These matters all affect the interests of various departments, which will make different, contradictory requests. If these contradictions are well handled, the benefits will outweigh the disadvantages, and generally this will help promote the early construction of hydroelectric power stations, producing many benefits. Conversely, the contradictions may drag out the construction of a hydroelectic station or even prevent it from producing the benefits which it should produce after construction. We must consider the problem from all sides, and when developing our country's water power resources we must engage in comprehensive planning and take account of all spects, reach suitable arrangements, and exploit resources in an economically rational manner. The overarching government departments should arrange matters with the offices and localities affected and should coordinate matters effectively. Currently, an especially difficult matter in the construction of hydroelectric power stations is compensation for flooding and resettlement of the population. The areas and organizations which will benefit from a dam always want it to be somewhat higher and the reservoir somewhat larger, while the areas and units to be flooded always want the dam to be lower and the reservoir smaller. In dealing with these problems, the planning departments must take a comprehensive view and make a concrete analysis. On the one hand, they should do everything possible to avoid building high dams and large reservoirs in areas where there are large population concentrations and large amounts of agricultural land upstream, while on the other hand they should build some high dams with large reservoirs whose benefits outweigh the harm they do. In the past, some projects did produce benefits which far outweighed the harm they did, such as the Liujiashan Hydroelectric Stations, which inundated 77,000 mu of agricultural land and caused the resettlement of 33,000 persons but had an installed power of 1.225 million kW, making it the largest main power station in the northwest, and also enabled Lanzhou City's flood protection standards to improve to the level of one flood in 50 years, while the regulated river flow also guaranteed irrigation for more than 10 million mu of agricultural land downstream. The Xishui Hydroelectric Station in Hubei flooded 47,000 mu of agricultural land upstream and caused the resettlement of 49,000 persons, but it had an installed power of 40,000 kW, irrigated more than 500,000 mu and gave flood protection to between 20,000 and 30,000 mu of land. Such projects were rightly undertaken, and projects similar to them should be supported by the state. In the past, there were in fact many problems involved in flooding compensation and resettlement, and in some cases the production activity and living arrangements of the persons displaced still had not been settled more than 10 years after the dams were

in operation. The amount of arable land per capita in this country is small, and most agricultural land is located along the banks of rivers, so that special care must be taken in deciding to build reservoirs which flood land and displace people, and every effort must be made to select projects which flood the least land and displace the fewest persons while producing the greatest benefit. In handling compensation for flooding, the principal dealings should be with the locality, the organization in charge of construction should coordinate the work, leadership of resettlement work should be intensified, and rational compensations should be made out of funds specifically earmarked for the purpose with consideration of the interests of state, collective and individual alike, and resettlement work should be done effectively and within a fixed time. In addition, for reasons of navigation and the floating of timber, requests were sometimes made in the past for installations that were on too large a scale, and after they were completed the actual volume of passenger and goods transport and the amount of timber floated downriver were far smaller than the projected figures, so that the project was wasteful; but some other construction departments were only concerned with getting their hydroelectric stations built quickly, and gave insufficient consideration to navigation and movement of logs, with the result that these activities were hindered for a long period. Accordingly, when building hydroelectric power stations, consideration must be given to the interests of both the upstream and downstream areas and to the interests of industry, agriculture, transportation, forestry, aquatic products and the like, and the relationship between all these aspects coordinated, all contradictions resolved, and the greater interests and the lesser harms chosen; all of these approaches involve taking account of all aspects of the benefits of comprehensive utilization. Currently, in hydroelectric station projects where power generation is the main concern, where the investor organization is in the electric power industry, and where requests for comprehensive utilization necessarily increase the construction costs of a station, if we take account only of the construction cost of the station per kilowatt generated, we might reject projects which would produce large benefits from comprehensive utilization. In Europe, the United States and Japan, joint investment is used in the case of projects involving comprehensive utilization. For example, the investment in the Tedorigawa No 1 hydroelectric station project in Japan was shared among three departments: 45 percent of the investment was for power generation and was borne by the power development company, flood protection accounted for 33 percent of the investment, which was borne by the Ministry of Construction, and water supply accounted for 22 percent of the investment, which was borne by Ishikawa-Ken. If our country too were to implement shared investment in the case of comprehensive-utilization projects, the construction cost of hydroelectric stations would be decreased and the various departments would be aided in rational planning of the scale of the project.

To summarize the foregoing, by taking account of all factors and making a comprehensive analysis, we can gain a much clearer idea of the position which a hydroelectric station occupies in the power system and in comprehensive utilization of rivers and streams, as well as of its economic benefits, and can make the major effects of the station on power construction more evident, which helps the planning departments to consider how large a station should be built, at what locality and at what time. Currently, many economic comparison methods are used in this country and abroad to evaluate power production projects; we must develop a computation method which is well suited to this country's circumstances.

This country has rich coal and water-power resources, but they are unequally distributed geographically, and in electric power construction the emphasis must be placed on working out a rational distribution so as to arrive at the best solution for each area, to foster both hydroelectric and fossil-fired power and to make them complement each other. For example, there are plentiful water power resources in the northwest and north China and on the upper and middle reaches of the Yellow River, while coal is plentiful in Inner Mongolia, Ningxia and Shanxi, and if we were to build a series of large and medium-size hydroelectric stations on the upper reaches of the Yellow River and a series of large and medium-size fossil-fired stations in Inner Mongolia, Ningxia and Shanxi, we sould connect them into the Northwestern and North China power grids, transmitting hydroelectric power eastward and fossil-fired power westward. Again, we could build large-size fossil-fired stations in Henan and large hydroelectric stations in Hubei and Hunan and connect them into the Central China power grid, making the hydroelectric and fossil-powered sources in the southern and northern sections complement each other. Furthermore, Guizhou has both coal and water power, Guangxi has water power but lacks coal, while Guangdong is short on energy resources; if Guizhou's hydroelectric and fossil-fired stations were netted together with Guangxi's hydroelectric stations, large quantities of electric power could be transmitted to south China. Further off, we could also consider using superhigh voltage transmission lines to transmit power from powerful sources in the southwest and northwest of the country to east China and the northeast. The construction of a large power grid could make even better use of hydroelectric power's and fossil power's ability to complement each other and overcome their shortcomings. When developing long-distance electric power plans, more study should be devoted to such overall strategic questions so as to develop power production systematically and in planned fashion over the course of years and to enable this country's power production to adapt to the requirements of the four modernizations.

8480
CSO: 4006/40

Improvements in Arch Dam Design Suggested

Beijing SHUILI FADIAN [WATER POWER] No 6, Jun 81 pp 3-4

[Summary of the Concluding Report in the Symposium of High Arch Dams by Ma Junshou [7456 0689 1108]: "Strengthen the Study of Arch Dams to Upgrade Design Standard"]

[Text] A symposium on high arch dams was held by the China Hydroelectric Engineers Association in Chengdu in November, 1980. Special topics talks were given and broad discussions were held in the conference and in group meetings on problems of arch dam stress and layout selection, abutment stabilization and overflow energy dissipation. The opinions and suggestions are summarized as follows.

(1) Stress analysis and layout design.

1. The principal methods currently employed in China for arch dam stress analysis are the trial-load method and the three-dimensional finite element method. It was suggested in the discussions that boundary condition studies and comparison analysis of these two methods should be strengthened so as to improve their accuracy and reliability. In the meantime, work should progress toward the investigation of nonlinear problems and other complex configurations such as considering concrete fracture factors in the trial-load method and taking fracture and engineering procedure into account in the finite element method. It was suggested that when the trial-load analysis leads to local weakness belt in the arch dam foundation, it should be supplemented by model tests or three-dimensional finite element analysis in order to obtain better results.

2. Allowable stress and safety factor of the arch dam concrete are important factors affecting the engineering safety and economic rationality. The allowable stress value presently used in China is somewhat different from that used by other countries, and strengthening of the analytical research in this area was recommended. Work should also be carried out on how to make the allowable stress compatible with stress analysis methods.

3. In the stress analysis of arch dams, the large effects of construction work and earthquake on the stress should not be neglected and a broadened research on load was recommended.

4. Layout has an important [illegible]ence on the body stress and abutment stability of the arch dam and research [illegible]s area should be strengthened. For example, the arch section needs not be restricted to a circular arc and the cantilever section can also have other appropriate shapes.

5. There are many computer programs in China for analyzing arch dam stress, but they are not unified, mostly not evaluated, and some require excessive preparatory work. It was recommended that the responsible departments should organize the effort and establish a reliable universal program that meets the current needs in China as soon as possible.

6. Optimization of the arch dam layout design is the direction for future development. It is characterized by the extensive use of computers and is capable of

obtaining a correct layout plan for the body model within a short time period. It reduces the work volume of design computation, speeds up the design progress and decreases engineering volume as well. Research in this area should be strengthened in the future.

7. Research on arch dam dynamic analysis should be reinforced in order to meet the needs of building arch dams in earthquake zones.

(2) Abutment stability and foundation treatment

Abutment stability is the basis for arch dam safety and is of extreme importance. The stability analysis involves many factors, all requiring further study.

1. Based on dam engineering experiences accumulated here and abroad and according to the current situation in China, the rigid body limit equilibrium method is still the principal method of abutment stability analysis at present. The equatorial plane projection method developed on this basis can also be pursued further. Due to the intrinsic limitations of these abutment stability analysis methods, they may not be completely valid for complex foundations that deviate substantially from the rigid body assumption, or for foundation with glide planes having complex spatial geometry (for example, staircase glide plane or multiple glide planes). In such cases, other appropriate methods should be sought, or studies can be conducted through experimentation and supplemented by finite element analysis.

2. In the long run, it is essential to carry out elastoplastic finite element analysis and experimental investigation on complex foundations or foundations with local weakness zones. A reasonable method for abutment stability analysis can also be explored by incorporating the fracture mechanism in rock mechanics.

3. Experimental analysis and research work on factors having great effects in abutment stability analysis, such as reaction force systems, various parameters, and the spatial distribution of structure surfaces, should be strengthened and their use should be selected with care.

4. In addition to computational analysis, reinforcement measures proved to be effective in the past should be considered when necessary in order to improve the abutment stability. More emphasis on this activity was recommended.

(3) Discharge energy dissipation and joints layout

1. Most of the high arch dams in China are built in deep river valleys where the volume of water flow is great, riverbeds are narrow and joints layout is difficult. Also, in regard to the energy dissipation aspect, there exist different degrees of washout problems of the downstream riverbank and riverbed which could affect the bank stability and cause abutment instability and high tailwater level. Attention should be paid to such problems. The drop point of overflow over the crest of a double-curvature high arch dam is usually close to the downstream toe of the dam, thus making the energy dissipation problem even more acute and may also lead to vibration problems. The discharge energy dissipation and overtopping impact problem should therefore be considered carefully and studied together with abutment stability and joints layout.

2. In order to solve the problems of the narrow river valley at the dam site, centrally converging overflow water and the large single width flow volume, further investigation should be made on the various spillway layouts currently under study, such as, energy dissipation via overflow collision, slotted bucket, spillway incorporated with powerhouse, and ski jump overflow powerhouses.

3. To solve the overflow problems of high arch dams, the hydraulic problems in high waterhead overflow such as turbulent boundary layer and gas admixture should be studied further. More advanced studies of the spillway surface curvature are also recommended.

(4) Some design questions of the Ertan arch dam

In the meeting, Chengdu Institute of Survey and Design presented the design of Ertan arch dam and the problems existing in the design. Group discussions were subsequently conducted and the following opinions were put forth for consideration:

1. In addition to analyze the abutment stability using rigid body limit equilibrium method as the principal method of analysis, it was also suggested that an integrated study should be made in which other methods such as finite element method and fracture mechanics analysis are incorporated. In the analysis, all the detrimental factor should be given full consideration so as to insure safety. In selecting the glide boundary, combinations of different structural surfaces should be considered in order to avoid neglecting the most unfavorable combination. It was recommended that equation used in the computation should be based principally on shear forces and the employed safety factor also deserves further studies.

2. Because of the great height (240 meters) and the large reservoir of Ertan arch dam, and because there are major local geological structures nearby, adequate attention should be placed on aseismic problems, including dam induced earthquake. More efforts on the research of dynamic analysis were suggested.

3. Assuming the engineering quality can be maintained, the current standard of allowable stress is appropriate. Stress analysis, however, can be carried out to a greater detail. For example, more efforts can be directed toward the investigation of boundary effect and influences of cracks. Body stress obtained by trial-local method near a weak zone of the foundation rock may tend to be too large, results by model tests and finite element method are probably more reasonable.

4. It was suggested that joint layout and overflow energy dissipation should be further investigated in order to come up with more mature proposals.

5. The success or failure of the engineering project depends on the crucial work of early phase survey or design to obtain reliable first-hand survey and test data. Inadequate survey, study, and design will prevent the technical measures from being placed on a solid basis and will inevitable lead to waste and loss due to redundances in the project and even affect the safety of the construction. Lessons learned in the past in this area should be well heeded. As compared to the investment made on the construction engineering project, costs of the early phase work constitute only a small percentage and yet it has profound effects. Attention to the early phase effort is called for.

6. In the design of high arch dams in foreign countries, great emphasis is placed on the foundation treatment. It was recommended that foundation treatment be made an important component of the preliminary design. The deformation modulus and condition of the foundation should be improved by treatment procedures in order to strengthen the abutment stability. For the Ertan dam project where the dam height and the ground stress are both large, great emphasis on foundation treatment is recommended and necessary investigative testing and design should be conducted.

7. Strength of the dam material is of vital importance for a high arch dam like the one planned for Ertan. Studies of material properties are therefore recommended. Assurance and improvement of the construction quality are of extreme importance and deserve great attention. The consequences are extremely serious if the construction quality of such a high arch dam cannot be guaranteed.

(5) The question of establishing China's arch dam design code

Up to now, China still has not established its own arch dam design code and designs are often conducted according to the design code of gravity dam and foreign data. This situation is not at all conducive to the current needs of arch dam construction. A Chinese arch dam design code is being drawn up in a joint effort of the Eastern China Institute of Survey and Design of the Ministry of Electric Power Industry and other units. This effort is highly significant in consolidating the arch dam construction experience in China and in promoting the building of arch dams. The responsible departments are urged to grasp this project well and other units are urged to lend support wherever possible so that the code can be compiled, certified and issued at the earliest possible date.

9698
CSO: 4006/19

Substation with Double Bus Bar Junction

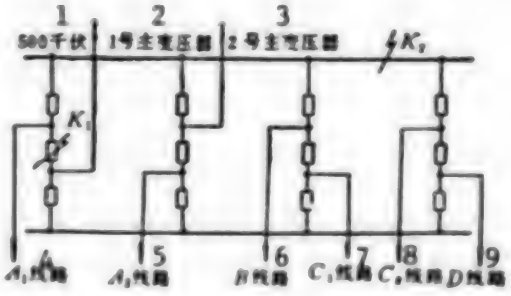
Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 8, 5 Aug 81 pp 30-34

[Article by Lan Zengjue [5663 1073 3778] of the Beijing Electric Power Design Institute: "Analysis and Comparison of the Design Scheme for a Double Bus Bar Junction in Four Sections and a 500 KV One and Half Circuit Breaker Junction"]

[Text] In recent years, our nation began to design a batch of master junctions of 500 KV for power distribution installations. Even though many types of 500 KV master junctions are produced abroad, but according to the actual situation in our nation, only two basic junction schemes, the one and a half circuit breaker junction and the double bus bar junction with bypass in four sections are used. This article takes the Fangshan 500 KV Transformer Substation as an example to analyze and compare these two schemes and to evaluate them.

The scale of the 500 KV power distribution installation of the Fangshan Transformer Substation is: 6 loops of output lines (including two loops of double circuit output lines), 2 master transformers, totaling 8 components.

When using the one and a half circuit breaker junctions, they can be organized into 4 series. To prevent simultaneous power outage of components of the same name (double circuit output line or master transformer), three principles have been taken into consideration in forming the series: (1) the components of the same name are distributed on different series; (2) the components of the same name are separately connected to different bus bars; (3) if one series is fitted with two lines, the power source line and the load line are coupled to form one series. The actual junction is illustrated in Diagram 1.



1. 500 kilovolts
2. No 1 master transformer
3. No 2 master transformer
4. A_1 line
5. A_2 line
6. B line
7. C_1 line
8. C_2 line
9. D line

Diagram 1 One and a half circuit breaker junction diagram

When using the double bus bar junction with bypass in four sections, to prevent simultaneous power outage of the components of the same name, components with the same name must be separated and distributed evenly on the two sides of the sectional circuit breaker of the bus bar. The actual junction is illustrated in Diagram 2.

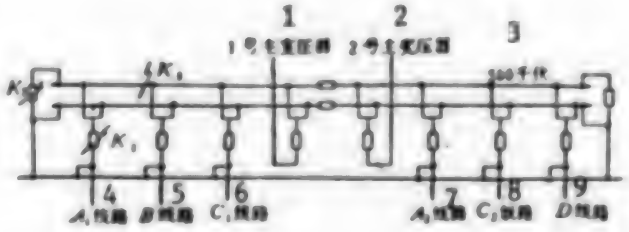


Diagram 2 The double bus bar junction with bypass in four sections

1. No 1 master transformer
2. No 2 master transformer
3. 500 kilovolts
4. A_1 line
5. B line
6. C_1 line
7. A_2 line
8. C_2 line
9. D line

I. Criteria of Reliability and Analysis

The transmission capacity of the 500 KV line is generally 1,000,000 to 1,200,000 kilowatts, the capacity of the master transformer is generally 500,000 to 750,000 kilovolt-amperes. Power outage on any line or any one of the master transformers will greatly affect the system. Therefore, when determining the main 500 KV electrical junction, it must be safe and reliable, and at the same time, it must satisfy the demands for easy inspection, repair and operation, versatile management, less investment and less space. Taking these demands as the basis for designing the 500 KV master junction, we have the following quantitative criteria for reliability:

1. When a breakdown of the circuit breaker (except the bus connection or sectional circuit breaker), the bus bar, line or transformer components occurs, the scope of power outage does not surpass 1/4 to 1/3 of all components.

2. When a breakdown of the bus connection or the sectional circuit breaker occurs, the scope of power outage does not surpass 1/2 of all the components.

3. When inspecting the equipment, breakdown of any component will not cause a total power failure.

The reliability of the two types of junctions is concretely analyzed according to the above reliability criteria:

1. One and a half circuit breaker junction. We know from Diagram 1 that when the equipment is not inspected, the scope of power outage due to a breakdown of the communications circuit breaker is 1/4 of all components. When the bus bar malfunctions, power shutdown is unnecessary. When the communications circuit breaker is inspected and repaired, the scope of power outage due to the breakdown of the bus bar circuit breaker is 1/4. The scope of power outage of a breakdown of the bus bar is 1/8. When a group of bus bars are inspected and repaired, the scope of power outage of a malfunctioning circuit breaker is 1/4. When another group of bus bars malfunctions, under the condition of a looped system, a shutdown of power is not necessary.

2. The double bus bar junction with bypass in four sections. It can be seen from Diagram 2 that when no equipment is being inspected, the scope of the power outage due to a malfunctioning line, master transformer, bus connection or sectional circuit breaker is 1/4 to 1/2. The scope of a power outage of a malfunctioning bus bar is 1/4. When the output line circuit breaker is being inspected and repaired, the scope of a power outage of a malfunctioning line or a sectional circuit breaker is 3/8 to 5/8. The scope of a power outage due to a malfunctioning bus bar is 3/8. When a group of bus bars is being inspected and repaired, the scope of a power outage due to a malfunctioning circuit breaker is 1/2 to 3/4. The scope of a power outage of a breakdown of the bus bar is 1/2.

The above analysis shows the comparative reliability of the two design plans described as follows:

1. When the circuit breaker breaks down, under a one and a half circuit breaker junction, the scope of a power outage does not exceed 1/4, and there are no components of the same name. The scope of a power outage of the double bus bar junction with bypass in four sections is 1/4 to 3/4. When the sectional circuit breaker malfunctions at the same time when a group of bus bars is being inspected and repaired, the scope of a power outage will reach 3/4, including components of the same name.

2. When the bus bar breaks down, the one and a half circuit breaker junction generally does not undergo a power outage. In very individual cases, the scope of a power outage is 1/8. The scope of a power outage of the double bus bar junction with bypass in four sections is 1/4 to 1/2.

It can be seen that the reliability of the components of the equipment of the one and a half circuit breaker junction is higher than the double bus bar junction with bypass in four sections.

II. The Power Distribution Installation and Analysis of the Structure

One and a half circuit breaker junction. According to the different positions of the three circuit breakers in one series, there are three schemes.

1. Three row scheme Two sets of bus bars are placed at the two ends, in the center, three circuit breakers are lined up in three rows, the single line position diagram is shown in Diagram 1. The dimensions of the power distribution installation is 302 meters long, 246 meters wide, the longitudinal dimension is greater. It is mainly suitable for side output lines. When output lines have to be in one direction, one series occupies two spaces, increasing the area required.

2. Flat ring scheme Two sets of bus bars are placed next to each other with a communications circuit breaker placed horizontally between the two. The three circuit breakers form a "loop", its single line position diagram is shown in Diagram 3.

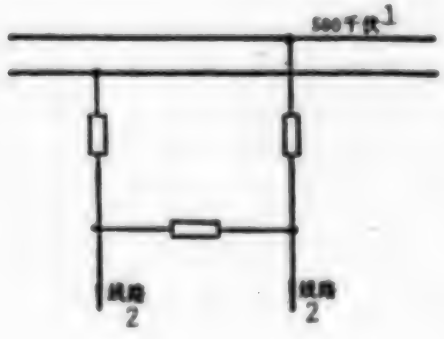


Diagram 3 Single line illustration of the flat ring scheme of the one and a half circuit breaker junction

1. 500 KV
2. lines

The dimensions of the power distribution installation is 222.5 meters long, 332 meters wide, the longitudinal dimensions are smaller, it can simultaneously provide output lines on one side or on opposite sides and it is more versatile.

3. Single row scheme Two sets of bus bars are separated, utilizing an upper layer slanted lead wire to connect the three circuit breakers positioned in one row into a series, its single line position diagram is shown in Diagram 4.

The dimensions of the power distribution installation is 211.5 meters long, 396 meters wide, and the scheme is also relatively versatile.

The three schemes described above can be used in the order of geographic positions in different series for double circuit output lines without requiring crossover and they can match the output lines in a versatile manner.

Analysis of the structure of the power distribution installation shows that each circuit of the one and a half circuit breaker junction requires only one set of bus bar isolating switches to connect with the bus bar. Selecting the type of isolating switches is easy. The power distribution installation can use the single layer frame. The pull on the lead wire is small and the structure is simple. Most of the circuit breakers of the flat ring and triple row schemes do not have live lead wires above them, and during inspection and repair of the circuit breakers, the influence of electrostatic induction is small. In the single row scheme, all circuit breakers have slanted lead wires above them, and this is unfavorable to inspecting and repairing the circuit breakers.

Summarizing the above, we see that the three schemes of positioning these types of junctions can separately suit the different overall schemes, and they have the advantage that the double circuits do not need crossovers, the positioning is versatile, the structure is simple, and inspection and repairs are convenient.

The 6 loops of output lines of the 500 KV power distribution installation of the Fangshan Transformer Substation exit in the same direction. There is a large and relatively deep trench in the direction of the output line near the transformer substation. The longitudinal dimensions of the power distribution installation must be relatively small. According to the above analysis, the flat ring scheme was used.

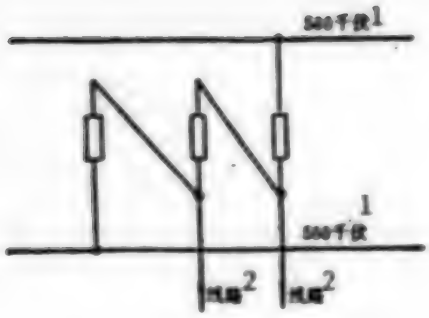


Diagram 4 Single line position diagram of the single row scheme of the one and a half circuit breaker junctions

1. 500 KV
2. Lines

The double bus bar junction with bypass in four sections. To conserve space, generally the single row scheme is used for positioning the circuit breakers, its single line position diagram is shown in Diagram 2. The dimensions of the power distribution installation is 201 meters long and 426 meters wide. Because the frame of the 500 KV power distribution installation is high, the influence of electrostatic inductance is great, and because the bus bar must be divided into four sections, there are three major problems in distribution and structure:

1. Because each circuit requires two sets of isolating switches in parallel connection with the bus, if the ordinary single row positioning on a double layer frame is used, the hanging point of the lead wire on the upper level reaches 35 meters, and at the same time, during inspection and repair, the problem of electrostatic induction is outstanding and with 500 KV, inspection and repair are difficult. Therefore, we can only use the keel type positioning on a single layer frame. At this time, we must use the scissor isolating switch and the selection of the type must be strict. At the same time, to assure reliable operation, we must also use a bus with a large tension and a small arc, thus the structure of the frame of the bus bar is complex, and the positioning scheme is singular and not versatile enough.

2. Because the double circuit lines cannot avoid output line crossovers (there are two crossovers in this case), the line structure requires setting up crossover towers of 40 meters high, causing difficulty in operation, inspection and repair and requiring construction in stages.

3. When the scale of expansion is not clear, the positioning of the sectional circuit breakers is more difficult, easily causing the sectional circuit breakers to be positioned on one side.

III. Economic Comparison

Economic comparison includes mainly the comparison of equipment costs and space. Because the master transformers and the electrical reactors of the two types of junction schemes are entirely the same, they will not be considered in the economic comparison. Only comparable equipment are compared. The economic comparison of the two types of junction schemes are listed in the table.

We know from the table:

1. The cost of the main equipment of the two types of junctions are almost the same, the one and a half circuit breaker junction is lightly more expensive (by 210,000 yuan, constituting 8 percent of total cost).

2. The area of land occupied by the one and a half circuit breaker junction is 80.6 percent of that required by the double bus bar junction with bypass in four sections, conserving 24.9 mu of land.

Economic Comparison of the Two Types of Junction Schemes

1	2		3	
4	5 数量	6 金额 (万元)	5 数量	6 金额 (万元)
7	14	1050	14	1050
8	36	396	48	528
9	18	720	12	540
10	6	108	10	135
11	2	39	2	39
12	8	192	8	192
13		2505		2484
14		100		99.2
15		0		−21
16				
17		69050(103.5)		85626(128.4)
18		100		124.1
19		0		24.9

1. Junction scheme
2. One and a half circuit breaker junction
3. Double bus bar junction with bypass in four sections
4. Name of equipment
5. Quantity
6. Cost (10,000 yuan)
7. Circuit breaker (set)
8. Isolating switches (set)
9. Current transformer (set)
10. Voltage transformer (set)
11. Power station lightning arrester (set)
12. Line type lightning arrester (set)
13. Cost of main equipment (10,000 yuan)
14. Percentage (%)
15. Difference (10,000 yuan)
16. Square meters
17. Land area occupied by 500 KV power distribution installation (mu)
18. Percentage (%)
19. Difference (mu)

IV. Technical Analysis

1. One shot operation, inspection and repair of equipment

One and a half circuit breaker junction. The isolating switch serves only as the isolating device, and it does not require reverse gating operations. In handling accidents, the circuit breaker can be utilized in operation and elimination of accidents is quick. At the same time, because the circuit breaker does not require a substitute circuit for operation, it can be shutdown at anytime for inspection and repair, and defects can be discovered in time and corrected in time, assuring that the circuit breakers are in good operating condition. Its one shot operating equipment is simple, operation is convenient, and the conditions for inspection and repair of the equipment are good.

The double bus bar junction with bypass in four sections. The isolating switch requires massive reverse gating maneuvers, easily causing accidents. At the same time, when handling accidents, operating the isolating switches is required and the speed is slow. When inspecting and repairing the circuit breakers, operation of relatively complex substitute circuits is required. Because there are only two circuit breakers serving as bypass circuits and concurrent bus connections, turnabout is not possible, affecting inspection and repairs. Therefore, its one shot operating equipment is complex, easily causing accidents, and inspection and repair of the equipment are inconvenient.

2. Relay protection of secondary line operation, inspection and repair

(1) One and a half circuit breaker junction

Line protection. The protective installation is connected to the two sets of current transformers. Because of the differences in the characteristics of the current transformers, when a nearby external breakdown occurs, the protective installation might misfire, and closing and locking circuits to prevent misfiring must be added. At the same time, when each series of the communicating circuit breakers refuses to operate, and to enable the opposite circuit breaker of another line in the same series to jump the gate, a distant jump gate device that is highly resistant to interference must be installed, thus complicating the protective device. When inspecting and repairing the protective device which is duplicated and which can be separately shutdown for inspection, it is rather difficult to test the drive of the circuit breaker.

Protection of the bus bar. Devices for single bus differential protection are simple in structure. When the bus bar protection device misfires, it jumps the circuit breaker of the main bus bar and the components will not shutdown. Inspection of the protective device can be done by shutting down one bus bar. At this time, if the other bus bar malfunctions, this will only bring about released row operation, power outage will not occur and the affect is small.

Protection against malfunction of the circuit breaker. The starting circuit consists of protective exits connected to two components and its own discriminating components. At the same time, it must use voltage discrimination components. The protective device and the voltage cutover circuit are more complex.

Current and voltage circuits. The current circuits of the protective devices of the instruments and the lines of the components must all be connected to the two sets of current transformers, cross connections are more complex, but the current circuit of the protective device of the bus bar has fixed connections and is relatively simple. The voltage circuits of each component are connected to the dedicated voltage transformer and do not require cutover, and thus they are relatively simple.

Controling and interlocking circuits. Because the isolating switch does not require reverse gating operations, there is no interlocking reverse gating between the components of the circuit breaker and the isolating switch, and thus the interlocking circuit is relatively simple. The controling circuit is more complex because the communicating circuit breaker is controlled by two components.

(2) Double bus bar junction with bypass in four sections

Line protection. The protective device is connected only to one set of current transformers, and at the same time, the line circuit breaker is completely connected to the bus bar, and the problems requiring protection against misfiring and the installation of distant jump gate devices that are highly resistant to interference do not exist. When inspecting the protective devices, the bypass circuit breaker can be utilized as a substitute circuit or the method of separate shutdown can be used. This is more convenient.

Protection of the bus bar. Because the bus bar is divided into four sections, there are more ways of operation, but the installation of two sets of structurally complex bus bar differential protection devices is required. At present, the commonly used specific phase bus bar differential protective device for double bus bars cannot be utilized yet. When the protective device of the bus bar misfires, 1/4 of the components will suffer a power outage. When inspecting the protective devices, one half of the bus bar loses its protection, and at this time, a breakdown of the bus bar will cause 1/2 of the components to suffer a power outage. The effect is great.

Protection against malfunction of the circuit breakers. For all circuit breakers of every component, the starting circuit requires only that the exit of the protective device of the component is a one-way output, and thus the protective device is much simpler. But, the bus bar connection, the sectional circuit breaker and the one and a half circuit breaker junction are the same, they must have two conditions to form the starting circuit, therefore their protective devices are still complex.

Current and voltage circuits. These are connected only to one set of current transformers and are relatively simple. The current circuit protecting the bus bar must follow the components that reverse the bus bar and correspondingly cutover, therefore it is more complex. The voltage circuits of each component must also cutover and are more complex.

Controling and interlocking circuits. There is operational interlocking and also reverse gating interlocking between the components of the circuit breakers and the isolating switches. At the same time, the circuit breakers also functions as the bus connection, bypass and sectional circuits, and the bus bar in four sections possesses various operating modes, thus, the interlocking circuits are very complex. The controling circuit is relatively simple because each component corresponds to one circuit breaker.

According to the above analysis, the degree of complexity of relay protection and of the secondary lines of the two types of junction schemes are basically equal.

3. Versatility for Expansion

One and a half circuit breaker junction. At the beginning, the output line circuits are few in number and when this remains so for a long time, simple angular connections must be used for transition, preventing the bus bar from forming series for a long period, and the advantage of this type of a junction cannot be fully developed.

At the same time, during the course of expansion, one-shot connections must be changed, and transition of secondary lines is also relatively complicated.

The first phase construction of the 500 KV power distribution installation of the Fangshan Transformer Substation had only three components, i.e., two loops and one set of master transformers. To overcome the above shortcomings, the plan to position the lines, transformer components and circuit breakers in two series in their final positions was adapted. One loop of the lines and one set of the master transformers formed a complete series, the other loop of the lines used double circuit breakers (one bus bar circuit breaker, one communicating circuit breaker) to form an incomplete series, thus avoiding changing the one-shot system during expansion. At the same time, terminal boxes were set up beside the current transformers of the communicating circuit breakers. The design of secondary circuits utilized measures of separation and independence so that expansion was relatively convenient.

Double bus bar junction with bypass in four sections. During expansion, the line or the transformer can be taken as a unit and can be independently installed, not affecting other circuits. This is more convenient.

V. Conclusion

Summarizing the above, we see that the design schemes of the one and a half circuit breaker and the double bus bar junction with bypass in four sections are respectively suitable for use under different conditions. Our nation's 500 KV power distribution installations will use these two types of junctions as the basic forms for connection and they will coexist.

1. The Fangshan Transformer Substation's 500 KV power distribution installation has used the one and a half circuit breaker junction scheme. It occupies less land, its reliability is higher, operational inspection and repairs are convenient, its structure is simple, the double circuit output lines do not create crossovers, positioning is versatile, it fits the topography well, and with such advantages, it is a better junction scheme.

2. The scope of suitable application of the one and a half circuit breaker junction

(1) Its scale is 4 to 6 loops of output lines, 2 sets of master transformers;

(2) The output lines have a double circuit line, and at the same time, the lines must exit in all directions, and the conditions for positioning are more difficult;

(3) At the beginning period of construction, the number of output line circuits is few, they last for a short time, and they possess the conditions for forming two series quickly.

At this time, the increase in the investment of this type of junctions is very small, and the advantage is that such junctions can be fully developed and they are more suitable. But when the number of output line circuits is too small, the two sets of bus bars cannot form a loop, and the advantages of the one and a half circuit breaker junctions cannot be developed. When there are too many output line circuits, the investment is too great and they are unsuitable.

3. The applicable scope of the double bus bar junction with bypass in four sections

(1) The scale is 8 to 10 loops of output lines, 3 to 4 master transformers;

(2) The output lines do not have double circuit lines, or even if there are double circuit lines, geographically, they possess the conditions for exiting in the opposite direction to the power distribution installation;

(3) The scale of construction in stages is more obvious.

At this time, the shortcomings in the positioning of this type of junctions can be overcome while the advantage of less investment is more outstanding, thus they are suitable for use.

9296
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Science, Technology Lead Hydropower Development

Beijing GUANGMING RIBAO in Chinese 11 Sep 81 p 3

[Article by Pan Jiazheng [3382 1367 6927], member of the Academic Department of the Technology and Science Department of the Chinese Academy of Sciences and Assistant Chief Engineer of the General Bureau of Hydroelectric Power of the Ministry of Electric Power: "Science and Technology Lead the Development of Hydroelectric Power"]

[Text] Our nation's deposit of hydroelectric resources is rich. According to the general national survey conducted between 1977 and 1980, it amounts to a total of 680 million kilowatts, of this, 370 million kilowatts can be developed, ranking first in the world. Since liberation, we built hydroelectric power stations with a capacity of 16.87 million kilowatts (referring to those with a capacity of over 500 kilowatts as of the end of 1980). Large achievements have been realized but these achievements constitute less than 5 percent of the amount that can be developed. Therefore, the development of hydroelectric power in a big way in the future has an important strategic meaning in solving our nation's energy problems and hastening the building of the four modernizations.

Recently, there have been more and more articles and opinions introducing the richness of our nation's hydraulic resources, describing the superiority of developing hydroelectricity and studying its economic gain and its investment and returns. This is a good phenomenon. But, we must also see the other side of the problem. That is, when we develop hydroelectric resources, we will face a series of difficult scientific and technical problems. Their degree of difficulty and complexity may be rare in the world. To develop hydroelectric resources in a massive way without studying and solving these problems is just empty talk. Solving these problems will bring our nation's hydroelectric construction and the level of hydroelectric science and technology to the front ranks of the world.

What are the difficulties and complex problems that have to be solved when developing our nation's hydroelectric resources?

First, viewing the geological conditions, many of our nation's large power stations will be built on violent earthquake regions, even near the dam sites, there are large active faults passing through. Among the hydroelectric power stations already built in our nation, phenomena of reservoir induced earthquakes have already occurred. This requires organizing geophysicists and earthquake resistance specialists to profoundly study the mechanism and the frequency of earthquakes, to predict their intensity, to study accurate and effective methods of dynamic analysis and propose corresponding measures.

Landslides caused by large reservoirs filled with water have reached a magnitude of several hundred million cubic meters in scale. The analysis, prediction, prevention and control of this type of damaging landslides are also problems that are far from being solved.

In the regions of concentrated hydraulic resources in our nation, there are many high mountains and deep valleys. In topographic conditions, they are good dam sites. But construction is difficult, especially the geological conditions are frequently more complex. For example, there are serious tectonic fragmented belts passing through, some river beds are covered by sand pebbles over 100 meters thick, they must be surveyed and analyzed by advanced technology so that effective and feasible treatment and measures can be carried out. We still lack experience in these aspects.

Second, in building construction, because the scale of the hydroelectric power stations is becoming larger and larger, extremely large structures of hydraulic engineering will have to be built, for example, especially tall dams, extra large underground tunnels, tubes that can bear extremely high pressure, digging long water conducting tunnels under tall mountains, etc. The continued enlargement of the scale of buildings will bring new topics of study in their surveying, design and construction, including topics in materials, structures, hydraulics and construction engineering. Simple dependence on engineering experience to design and to construct such buildings will gradually fail to adapt to the needs of huge construction projects. The practical situation requires us to propose more precise scientific data, and even to carry out some revolution. We must organize experts in applied mechanics, computational mathematics, hydraulics, rock mechanics, building materials to cooperate together and to create new ways.

Third, our nation's major hydraulic resources are distributed in the southwest and the northwest, especially concentrating in the southwestern border regions, very far from the region of major load. For this, we must solve the problem of long distance (over 1,500 kilometers to 2,000 kilometers) and large capacity (several million to several dozen million kilowatts) ultrahigh voltage power transmission (including high voltage equipment, direct current transmission of power, system stabilization and a series of problems). Future construction of large hydroelectric power stations also requires us to develop generators with a single generator capacity reaching the million kilowatt class and corresponding equipment. This again brings out many new topics in materials, structure, cooling and manufacturing technologies.

Fourth, building hydroelectric power stations requires flooding some land. Some hydroelectric power stations even require flooding large areas of cultivated land,

forming large reservoirs of several dozen billion cubic meters. In our nation with more people and less land, this will greatly increase the building cost of the power station and will also bring about a series of economic and social problems. Therefore, the building of some hydroelectric power stations has not been included in the daily agenda. Here, we are presented with a problem: Can the broad expanse of water surfaces provide food and other materials for living equivalent to the cultivated land? From the viewpoint of "cosmic food grains" this should be possible. In the past, because of insufficient emphasis on this question, a systematic study of the problem was not carried out, thus, the presently available several dozen million mu of water surface of the reservoirs have not been comprehensively utilized well. In addition, the building of large reservoirs will cause profound and far reaching effects in the environment. There are benefits and disadvantages. We must organize scientists in biology, ecology, aquatic products, mud and sand and environmental protection to carry out detailed research and experiments.

The many problems and difficulties mentioned above are not aimed at discouraging the building of hydroelectric power, conversely, they are for more hydroelectric power construction. To develop our nation's rich hydraulic treasures, we must pragmatically solve these difficulties in science and technology and place this work before construction. Some work require a long period of hard study before they can produce visible results, if we do not start now, "digging wells when thirsty" will not solve the problems. For this, we suggest selecting two or three rivers that are suitable in location and in size and that are connected with the above problems, such as the upper reaches of the Huanghe, the Hongshui river in Guangxi, Yalongjiang in Sichuan (each has a capacity of over 10 million watts, the electricity generated can be distributed separately to northern China, southern China and central China) as the sites for near term development and study. Scientific research, survey and design and construction must be organized according to plan and step by step to accumulate data and experience and to establish a firm foundation for the further development of our nation's hydraulic resources on an even larger scale.

9296
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Miaotiao River Hydroelectric Cascade

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 7, 12 Jul 81 pp 50-51, centerfold

[Article by Liu Yizhou [0491 5030 3166], Survey and Design Institute, Engineering Bureau No 9, Ministry of Power: "An Introduction to the Miaotiao River Cascade of Hydroelectric Stations"]

[Text] The Miaotiao River is a tributary flowing into the Wujiang River from the south and forming part of the Yangtze River system. It has a total length of more than 180 km and a head of 549 meters, with an average rate of fall of 0.305 percent. It drains an area of 3,113 square kilometers. Its upper reaches are in a hilly region, while in its middle reaches the hills change to mountains, and its lower reaches are in an area of high mountains and narrow valleys, with terrain variations of 300 to 400 meters. The average air temperature in its valley is 13.8°C and the average rainfall 1,300 mm. The river has been developed in a six-level cascade (see figure) in which the individual levels are interconnected; the total utilized head is 384.5 meters, and the total equipment capacity is 239,000 kW.

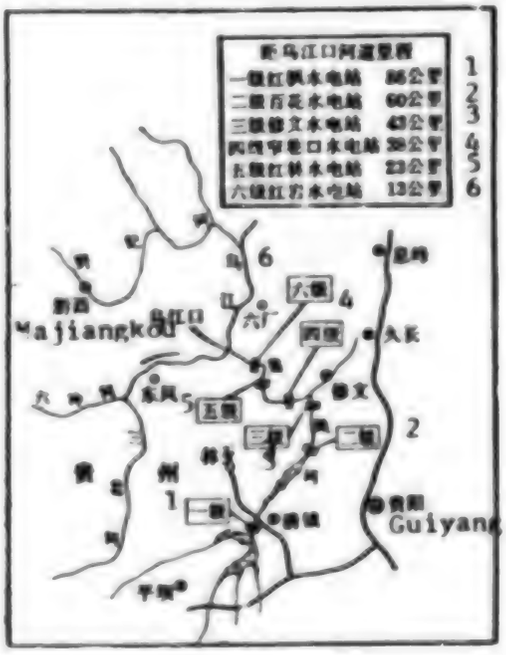

Fig. 1. The Miaotiao Cascade of Hydroelectric Projects

Key:
1. Level 1: Hongfeng Hydroelectric Station, 86 km.
2. Level 2: Baihua Hydroelectric Station, 60 km.
3. Level 3: Tiaowen Hydroelectric Station, 43 km.
4. Level 4: Zhaixiangkon Hydroelectric Station, 38 km.
5. Level 5: Honglin Hydroelectric Station, 23 km.
6. Level 6: Hongyan Hydroelectric Station, 13 km.

The valley has an extremely complex geologic structure, more than 70 percent of which consists of carbonate rock, with extensive karstification, producing problems of seepage from reservoirs and problems of foundation stability of hydraulic engineering works. To deal with this problem, the relevant design and construction organizations have used such methods as enclosure, plugging, grouting, paving and damming, in accordance with specific local topographic, hydrologic and geological conditions; starting in 1958 they have built six different hydroelectric stations with dams of different design and have accumulated invaluable experience in dam construction in karst regions. Below we give a brief introduction to the construction of the six power stations in the cascade.

Level 1: The Hongfeng Station

This station is located 35 kilometers southwest of Guiyang City. The regulated area of the reservoir is 1,551 square kilometers, equivalent to 50 percent of the total length of the river, making it the largest reservoir in the cascade, with a total capacity of 601 million cubic meters. The total amount of construction earthwork was 492,000 cubic meters, and 55,400 cubic meters of concrete was emplaced.

The geology of the dam area is Triassic Qingyan limestone interbedded with thin layers of sandy shale, with the dip facing upstream. The pressure resistance of this shale is over 1,000 kg/cm^2 and the friction coefficient is 0.45. There are more than 20 faults of various sizes in the dam area, with fracture zones of rather limited width. The F7 fault has a maximum fault displacement of 15 meters, and consists primarily of cemented gravel, which was handled by curtain grouting.

The power station building was built at the surface of the river bank and has an installed equipment capacity of 2 x 10,000 kW. The dam is of the rockfill type with a timber facing and is 52.5 meters tall. The timber facing consists of three layers of mortise-and-tenon planking. The cushion and compression timbers are bolted into 1-meter-thick concrete. The lower part of the facing is flexibly joined to the concrete to wall to allow it to adapt to deformation of the rockfill dam. Locomotives and trucks were used to haul the rock for construction of the dam.

The project was began in 1958, and the first generating unit went into operation in May 1960, with completion of the construction work in September 1960. After the main dam was constructed, many years' monitoring indicated a maximum displacement of 30 cm and a settling of 38 cm, satisfying design requirements.

Stage 2: The Baihua Hydroelectric Station

The dam is a rockfill type with an impervious reinforced-concrete facing and is 48.7 meters high, with a reservoir capacity of 182 million cubic meters. The power house is built at ground level on the bank, and the installed equipment has a capacity of 22,000 kW (1 x 10,000 and 1 x 12,000 kW).

The geology of the dam area is Shabaowan shale 31 meters thick, underneath which is 41 meters of Changxing limestone. The shale is highly impervious to water, its pressure resistance is 150-500 kg/cm^2 and its friction coefficient 0.3 to 4.0, all of which meet the requirements for construction of a rockfill dam. However, the geological structure under the secondary embankment on the left bank has much

fissuring, and the Shabaowan shale is weathered and fractured to a depth of 10 to 20 meters, allowing a serious degree of percolation, so that in addition to securing it by grouting in deep box-type holes, during construction of the dam the pervious area was walled off from the reservoir.

The construction work on the rockfill dam was basically similar to that on the first-level [Fengshui] hydroelectric station, except for the use of a rigid facing. During construction the concrete supporting layer and the rockfill were completed first, than when it was judged that the pressure would be stable when the reservoir was filled, 15 x 10 meter slabs of reinforced concrete were poured. In order to meet watertightness and deformation requirements, the seams were filled with bitumen and channel copper, making them impervious to water, the area between the facing and the supporting layer of concrete was filled with bitumen-impregnated burlap, and an articulated joint was made between the bottom of the facing and the toe wall. The earth work for this project amounted to 960,000 cubic meters, and 88,000 cubic meters of concrete was emplaced. Work began in 1960 and the first unit went into operation in June 1966, with project completion in December 1966. After the reservoir was filled, observations indicated that the main dam did not leak, and that displacement and settling were both smaller than for the first-level station.

Fig. 2. The Baihua Hydroelectric Station

Third Level: Xiuwen Power Station

At the site of this dam, the river valley is narrow and U-shaped, and the dam is an arch type. The powerhouse, located behind it, has an overflow roof. The dam is 49 meters tall, 8.29 meters thick at its base, and 3 meters thick at the crest. The reservoir holds 11.4 million cubic meters of water and is of the daily regulation type. The power station equipment has a capacity of 2 x 10,000 kW.

The dam is built in middle and upper Cambrian dolomite dipping slightly toward the two banks and upstream at an angle of 6 to 8°, with many incompetent muddy intercalculations, and with small faults at both ends of the dam arch. The dolomite structures are extensive, and a broadened base and expanded arch abutments and anchoring fixtures were used to improve the foundation stress situation. Karstification decreased with depth, and fissuring and solution erosion of the riverbed were extensive, so that the permeability was high. A double grout curtain was used to prevent leakage in the foundation.

The left dam abutment was steep, and 80 meters of open excavation would have been required; instead, three horizontal tunnels were cut at different levels and vertical excavations conducted simultaneously, decreasing the amount of excavation work required. Weathered dolomite was made into sand for the construction work. The concrete system was applied in a downward direction, relying on the natural pressure head to introduce the curing agent. The power unit was lowered into place with a cable hoist developed for the project, thus dealing with the difficulty of building an approach road to the power house.

This dam involved 37,800 cubic meters of earth work and 49,700 cubic meters of concrete. Work was begun in 1960 and the first unit went into operation in June 1961, with project completion in July 1961. Since the plant went into operation, the overflow speed over the dam and the power house has reached 17-19 meters per second, with no indication of friction damage or erosion of the concrete. Other than a few induced vibrations in the dam, no resonance phenomena have been noted, and the power station's operating characteristics have been excellent.

Fig. 3. The Xiuwen Power Station

Fourth Level: Zhaixiangkou Hydroelectric Station

This power station uses a double-curvature arch dam; an arched bridge spans the river and the double-curvature arch dam is built on top of it. The dam is 54.8 meters high; the reservoir contains 7.08 million cubic meters of water, and is of the daily regulation type. The power station is a run-of-river type and the machinery has an installed power of 3 x 15,000 kW.

The dam is located in a deep river gorge in which the exposed rock is Jurassic Qixia coal and Yangxin limestone. Because the right bank is affected by the F71 fault, with intense fissuring, and the rock is weathered and fractured, its strength is not uniform, and the geological conditions are complex. During construction work both open excavation and tunnel excavation were used, and when fresh rock was reached, a concrete backfill was used, on top of which a 1.6 meter layer of concrete was laid down as a dam abutment support, after which deep-hole reinforcing grouting was used on the dam. The river bed is filled with sand and gravel to a

depth of up to 27 meters, and the design approach was that of construction on an uncleared foundation, which involved using an arch bridge between the two banks, on which a double-centered arch dam was constructed, while a reinforced concrete wall was used to block the water in the riverbed covering layer.

"Ski-track" spillways were used on top of the dam. In order to keep pothole formation far from the dam and to assure stability of the watertight wall, a 46.5 meter long overflow structure was added, supported by two 8 meter broad support arches, which has excellent energy dissipation capabilities.

Because this hydroelectric station's engineering structure is rather complex and the procedural requirements were rather demanding, a bypass tunnel was first cut; the holes for the waterproof wall were cut in the low-water season, and the concrete was cast underwater using reinforcing cages. The arched bridge and waterproof wall were joined by underwater slabs, and chemical grout treatment was applied to the joints between the foundations and the bridge. In the process of digging the penstock on the right bank, a sinkhole extending to the surface was found, and a supplementary arch had to be poured. Construction was begun in 1965, and the first power unit went into operation in October 1970, with project completion in July 1975. After completion of the power station, instrumental measurements and water table determinations behind the dam showed that the design of the reinforced concrete watertight wall and double-arch dam was successful, and that the quality of the construction work was excellent.

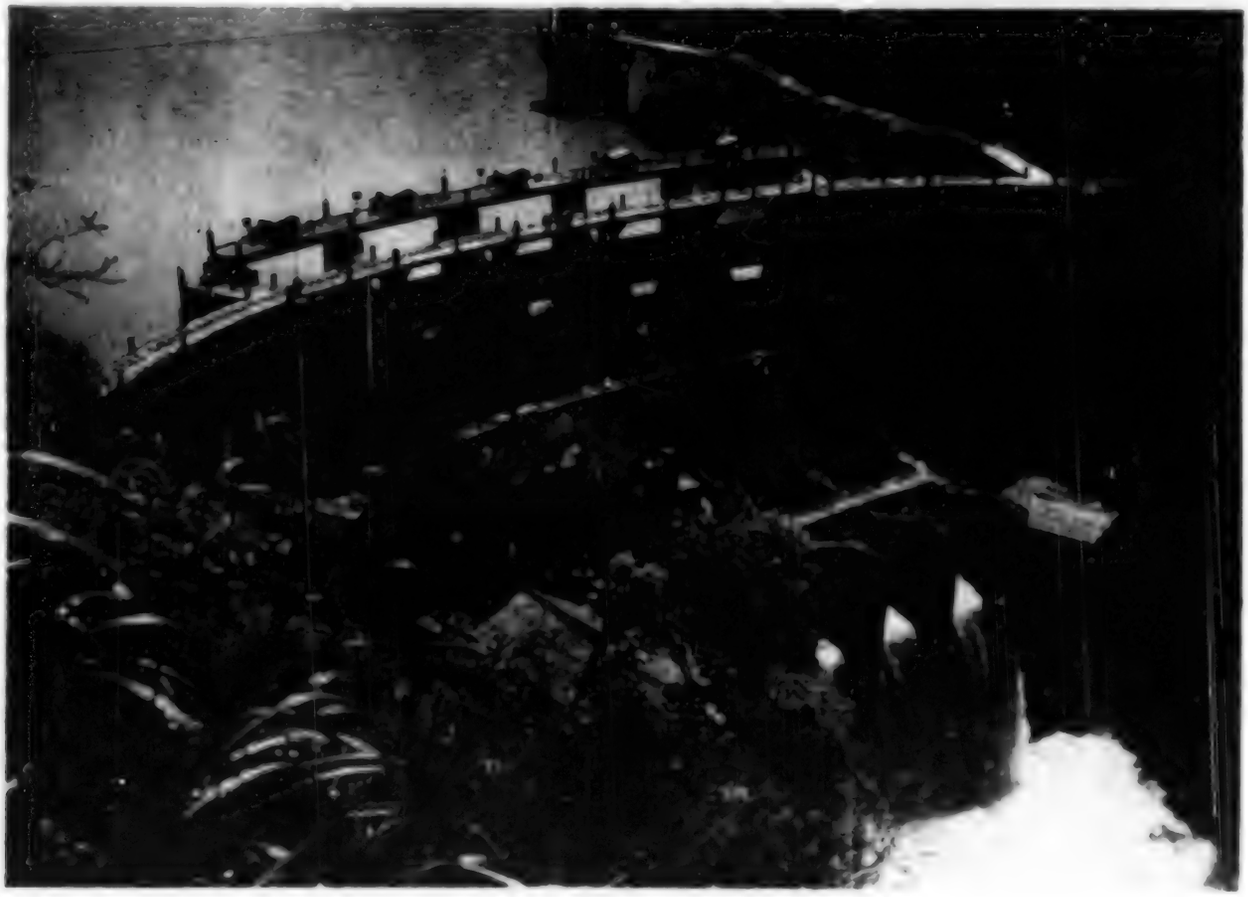

Fig. 4. Zhaishangkou Hydroelectric Station

Fig. 5. Zhaishangkou Arch Bridge

Stage 5: The Honglin Hydroelectric Station

This power station uses a gravity dam 22.5 meters high with free spillover at the crest of the dam. The reservoir capacity is 770,000 cubic meters, and there is no regulating function. The hydroelectric station is a run-of-river type with a ground level power house, and the generating equipment has a capacity of 3 x 34,000 kW. The total penstock length is 5,316 meters, and the diameter 6 meters. The pressure regulating shaft is an overflow type with a lower chamber and is 24 meters high with an internal diameter of 12 meters.

The base on which the dam rests consists of middle and upper Cambrian dolomite and small quantities of incompetent intercalations. The rock layers dip towards the right bank and slightly downstream; the dip angle is 25-40°. There are ten faults passing through the dam, either along the river bed or intersecting it, and during construction reinforcement grouting and anchor rods were used to strengthen the dam's foundation. The tunnel is about 200-300 meters below the surface, and its line passes through strata consisting of dolomite, limestone, coaly shales and coal strata, with 22 main faults and two underground watersheds.

The tunnel was built by combined drilling and blasting and by domestically-developed full cross section cutting machinery. The linings were reinforced concrete, plain concrete, and gunite. Because of the geological complexity of the tunnel line, there is considerable subsurface water activity, and during construction there were 27 cave-ins, which were generally dealt with by using injected anchor supports, while in a few sections injected anchors and steel props were used in combination. In addition, coal beds were penetrated 11 times, with maximum gas concentrations of over 10 percent.

When making and installing the steel pipe, the overlapping seam disassembly method was used at branches having crescent-shaped strengthening ribs, making welding easier when expanding it to the original shape and making it possible to avoid extensive longitudinal welds. Work on the stage 5 power station began in 1966 and the first unit went into operation in December 1979.

Fig. 6. Honglin Hydroelectric Station

Level 6: The Hongyan Hydroelectric Station

This hydroelectric station has a double-curvature arch dam with mid-level outlets, which is 60 meters tall, 9.03 meters thick at the base and 3 meters thick at the crest; it has a reservoir capacity of 30.4 million cubic meters, and is of the daily regulation type. The power house is a run-of-river type and is built at the ground surface, with short penstocks; the installed machinery has a capacity of 2 x 15,000 kW.

In the dam area the lower-level geological structure consists of Triassic Yongningzhen microgranular limestone of varying thickness and finely crystalline dolomite, while the upper section consists of moderately thick to thin strata of finely crystalline dolomite, marly dolomite and the like. Bedrock is exposed in the river bed, and the banks have little cover. Reverse fault No F31 is 5 to 10 meters upstream of the left arch abutment and dips upstream and slightly toward the left bank at an angle of 60-90°, with a fault displacement of 2-3 meters. The rock in the fracture zone is considerably disintegrated and consists of plastic clays and conglomerate, which has a negative effect on compression deformation at the end of the arch and on percolation.

Five mid-level openings measuring 7 x 6.4 meters are located 17 meters below the crest of the dam, each with a pit angle of 20° and with a flat gate on the downstream side. At the lower level is a 2.7 x 2.7 meter outlet. The stress on the arch dam was calculated by computer using a three-dimensional finite element procedure, and the results were close to those obtained in structural tests.

Because of the narrowness of the stream valley, during construction work the current was diverted at various times by an underwater cement coffer dam, after which the foundation rock was cleared and the dam built to the water surface level; during flood season the dam abutments and the two banks were cut, from the top down. The debris was removed by excavators and trucks, and all construction machinery and materials were hoisted down by a crane and a specially-developed hoist. Mixing towers were located on the right bank and at the power house. The concrete on the dam was laid in slabs 5 meters high and 15 meters long, with a crane used to lower the cement containers directly into the forms. The embankment at the location of the power house was cut with smooth-surface blasting, and the tailrace forms were hoisted into place and the concrete poured in situ.

The load-bearing capacity of the abutment rock was rather low, and in order to decrease the stress on the arch, the thickness of the right abutment was somewhat increased, by a maximum of 1 meter; in addition, a reinforced concrete cushion 1 to 2 meters thick was installed to increase the rigidity of the upper and lower parts of the dam and to make the stress on the ends uniform. In addition, the fracture zone of fault F31 was cleared and plugged. Using this as a foundation, curtain grouting and deep-hole reinforcement grouting were applied to the ends of the arch. Work on this station was begun in 1971 and the first unit went into operation in 1974; several years' operation indicates normal conditions.

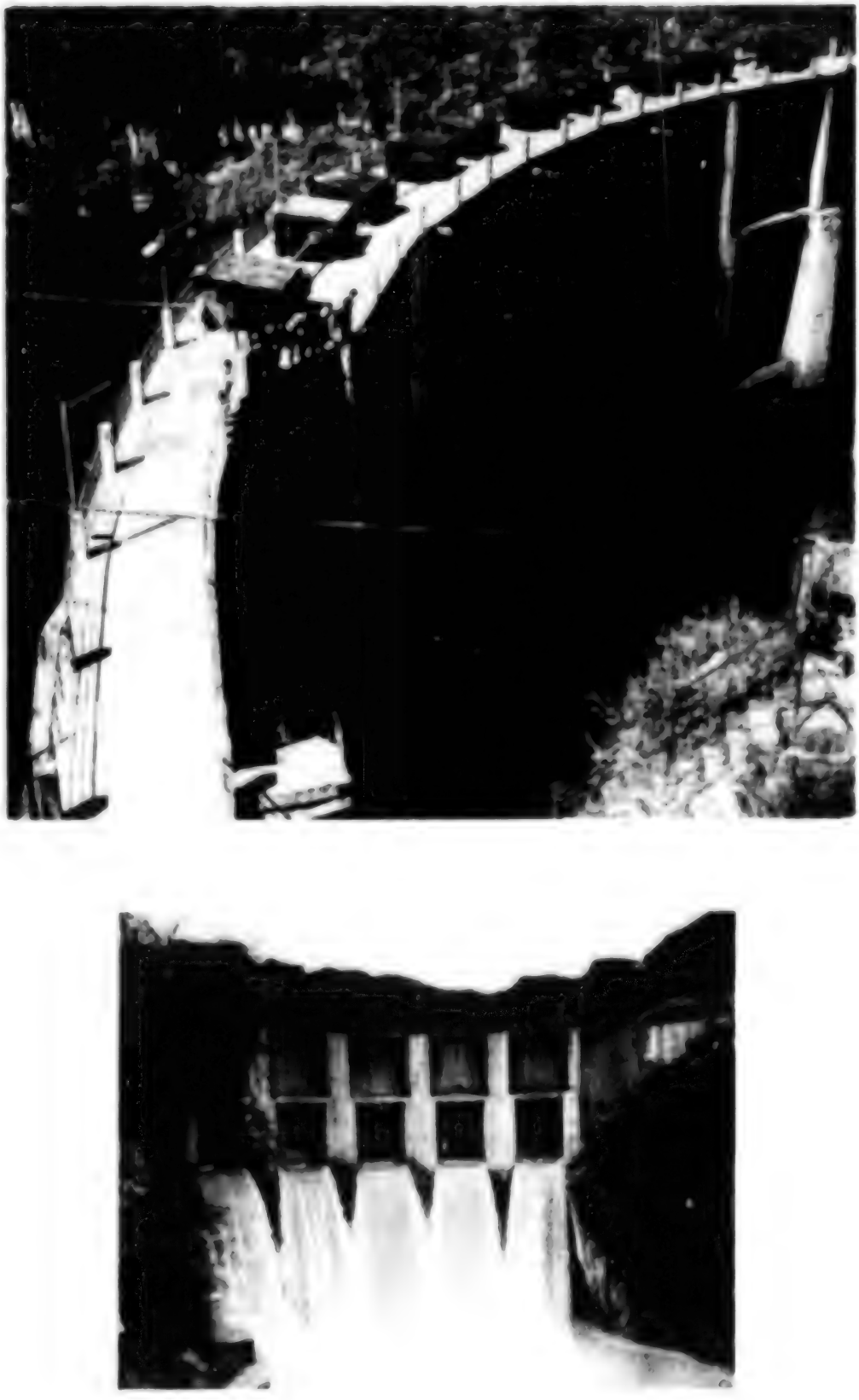

Fig. 7. Hongyan Hydroelectric Station

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Gezhouba Hydroelectric Project Progress

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 7, 12 Jul 81 p 3

[Article: "Impoundment, Navigation Provisions and Preparation for Operation at the Gezhouba Key Hydroelectric Project"]

[Text] Since the river was successfully spanned early this year at the Gezhouba key hydroelectric project, a half-year's effort has led to successful impoundment, the beginning of navigation through locks 2 and 3 and the third channel, and the completion and installation of power station unit 1, which is currently undergoing testing and adjustment in preparation for operation.

By the first third of May 1981, the earthmoving and construction of the installations of stage 1 of the main section of the Gezhouba project were essentially complete. Several months' inspection, measurement and operation were indicated that all this work meets design requirements, and it has all received intermediate pre-impoundment acceptance by the relevant state ministerial committees and design and operating departments. This testing and acceptance has applied to the cofferdam on the main channel, the tail section of the sluicegate on channel No 2, the water retaining wall and underwater sections of the power station building, the navigation route on channel No 3, locks Nos 2 and 3, the scouring sluice on channel No 3, the earth and stone embankment on the left bank and the water-retaining section of the Huangcao embankment. Following inspection it was concluded that the works were suitable for impoundment, and with reference to the requirements for interior and exterior measurements on the various installations at different water levels during the impoundment process and to hydrographic conditions, it was decided to begin impoundment on 23 May. The initial water level during impoundment was about 48 meters, and the discharge at the Ichang station before impoundment was 15,300 m^3/sec. The impoundment was carried out in four water-depth stages, and step-by-step readings were taken on the facilities during the process. After 13 days, the current reservoir operating level of 60 m was attained. Brief information on some of the main installations and equipment is given below.

1. The transverse cofferdam upstream on the main channel: The transverse cofferdam upstream on the main channel has a sand, gravel and stone shell and an impervious concrete core wall for its vertical watertight system. The top of the cofferdam is at a height of 66 meters, and the total amount of fill work was 26.6 million cubic meters. The watertight wall is double. The first wall's watertight area is 30,000 square meters; it was compacted up to the 55-foot level, then topped with a concrete wall. The cofferdam has already reached the design height, and the first watertight wall is complete. Curtain grouting of the highly pervious foundation section from tubular passages which were purposely left in the watertight wall is proceeding. Quality problems in the construction of the wall have been dealt with. According to observations and measurements following impoundment, the increase in the water level upstream has produced no evident changes in the water level in the foundation pit in the main channel. With the exception of minor damage, the 69 strain gages, clinometers, soil pressure boxies, joint monitoring devices and zero-stress meters embedded in the first watertight wall are operating normally. It is also planned to embed pressure tubes, percolation pressure meters, clinometers, sedimentation tubes, lateral pressure detectors and seismometers in the cofferdam in order to monitor it.

2. The sluicegate on the secondary channel. This sluicegate is divided into the housing and the protective apron. The housing has a total of 27 openings arranged in two levels, each measuring 12 x 12 meters, with the upper flat and the lower arched. It is already more than half a year since the first works were placed in the stream and the flow divided. Especially following impoundment of the water, the sluicegates have been used frequently in order to keep the upstream water level relatively stable, and the arched gates and gate-lifting mechanisms have been tested singly and in groups and shown to meet design requirements, in addition to which the hydrodynamic characteristics also meet design specifications. Currently the 2 x 250 ton gating mechanisms atop the dam are undergoing load tests related to operation of the upper flat sluicegates, emergency inspection and repair, and handling flood stages. No abnormal conditions have been observed during use of the protective apron; measurements of water leakage through the troughs and channels below the apron and measurements and numerical analysis of flow through the foundation openings indicate that they are all smaller than the design values. Because of the low Fo [0154] number, energy dissipation results are rather poor, and the downstream area affected by waves is greater than predicted.

3. The power station on the secondary channel. The rockfill of the broad channel for the main machinery section of the power station meets the reservoir height requirements. The intake gate and tailrace gate or "plug" have already been used to block water flow, and the intake debris screen is in place. The installation area and the section for block No 1 have already been sealed, and preparations are made for sealing off the areas for blocks 2 through 4. The main turbine of unit 1, with a capacity of 17,000 kW, a unit weight of 4,000 tons and a rotor diameter of 16.9 meters, has already been completely installed, and installation of units 2 and 3 by the end of the year is planned. The main transformer core has already been installed and inspected. Currently, turbine unit No 1 is undergoing adjustment and testing in preparation for operation.

4. Navigation canal and locks on third channel. Dredging of the Nanjinguan navigation channel is complete, and the underwater concrete protective embankments have been completed at the upper and lower entrances. Final construction details are now being completed at the upper and lower entrances. Final construction details are now being completed. Following completion of the earth moving and of the structures, metal framing and electrical equipment installation on locks Nos 2 and 3, tests and adjustments were made in both emptied and filled condition, and test passages were made by boats. Tests and measurements indicated that the hydrodynamic characteristics of the filling and emptying facilities for the locks were excellent, the filling and emptying rate was high, and vessels were raised and lowered smoothly inside the locks. The V-shaped gates operated smoothly, their water retention capability was good, and in particular the gate of No 2 lock, 34 meters high, consisting of two sections 19.7 meters broad weighing 600 tons each, was installed with a precision meeting design requirements and gave excellent results during test operation, making it possible to resume direct passenger and freight service between Hankou and Chongqing.

5. Monitoring of the project. Because the operating conditions for the Gezhouba project are complex, and the technical specifications for the various installations are exacting, in order to assure safe operation and to carry out design and scientific research and accumulate data, large numbers of monitoring instruments have been imbedded in the works; most of them are in good operating condition. For

example, 2,058 prototype instruments have been imbedded in the main dam (including the cofferdam upstream in the main channel), and 95 percent are working properly; all have been including in systematic monitoring. Monitoring work on the Gezhouba project includes monitoring of deformation of the external part of the main dam, monitoring of the interior of the main dam, percolation pressure monitoring, hydrodynamic measurements and the like. Judging from the first stage of measurements, the operating conditions of all of the installations are excellent; no abnormal conditions have been found in internal and external monitoring.

The virtual completion of the first stage of the Gezhouba project, the beginning of its operation and realization of the first benefits of its construction are an indication of our country's further progress in the modernization of hydroelectric construction. The flood season has arrived on the Yangtze, and the various works are currently facing their first flood-season tests since they went into operation. Preparation for the second stage of the project has already begun, involving extremely arduous engineering tasks, and all of the builders have resolved to redouble their efforts, advance victoriously and build the Gezhouba dam with high speed, high quality and high standards.

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Longtan Dam Selection Conference

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 7, 12 Jul 81 p 51

[Article: "Dam Selection Conference For Longtan Hydroelectric Station Held in Nanning"]

[Text] The Ministry of the Power Industry and the People's Government of the Guangxi Zhuang Autonomous Region recently held a joint dam selection conference for the Longtan Power Station on the Hongshui River. The conference was attended by representatives and experts from the State Construction Committee, the Ministry of Water Conservancy, the Ministry of Communications, the Ministry of Metallurgy, the Institute of Geology, CAS, the Scientific Research Institute of Water Conservancy and Water Power, the Pearl River Committee of the Ministry of Water Conservancy, the Office of Hydrogeology of the Ministry of Geology, the Guizhou Province Construction Committee and Electrical Power Office, the Guangdong Province Earthquake Office, the Shaanxi Province Hydroelectric Power Office, Guangxi University, the Liuzhou Railway Office, relevant units of the Guangxi Zhuang Autonomous Region and some design institutes and engineering bureaus in the Ministry of Electric Power system, and unit No 00619. The conference participants heard a report by the Central South Survey and Design Institute, made an inspection of the site, conducted serious discussions, and finally reached unanimity of views on dam selection, approving the Longtan Dam proposed by the Central South Survey and Design Institute.

The Hongshui River has plentiful water power, with a usable head of 374 meters in seven stages between Longtan and Dateng Gorge; the installed capacity is 8.34 million kW, and annual power output is 42.9 billion kWh, making it a "bonanza" in our country's water power construction. Longtan is located on the upper reaches of the Hongshui river and regulates an area of 98,500 square kilometers, accounting for 75.3 percent of the Hongshui River watershed area; the multiyear average discharge is 1,590 cubic meters per second. The annual runoff is 50.2 billion cubic

meters. After the Longtan Hydroelectric Station is completed, it will supply electricity for the Guangxi nonferrous metals base and Guangdong and Guangxi provinces and autonomous regions, and will make it possible to integrate south China into the unified power grid; the Longtan Hydroelectric Power Station will be able to fully play its key role in the system, functioning as the system's main load regulation station.

The Longtan station is intended primarily for generation, but will also yield the benefits of flood prevention and navigation. Currently the scale of construction has not been determined, but when the normal water storage level is 400 meters the total capacity of the reservoir will be 27.46 billion cubic meters and the effective capacity 22.34 billion cubic meters. In run-of-river operation, it will assure an output of 1.53 million kilowatts. The installed machine capacity will be 4 million kW and the annual power output will be 18 billion kWh. It is thought that when the entire cascade goes into operation, the assured output at Longtan can be as high as 1.81 million kW and the annual power output 18.6 billion kWh. Because the Longtan reservoir is large, the storage regulation effect will be considerable, guaranteeing that the total output of the six downstream stages can increase by 1.61 million kW compared with simple operation, and the annual power output can be increased by 6.1 billion kWh. Accordingly, the Longtan Hydroelectric Station's motive power prospects are excellent. As regards flood protection, because of its excellent regulating characteristics, when combined with other flood protection measures it can provide a certain flood control effect for both banks downstream and the Pearl River delta region, and can improve navigation conditions both upstream and downstream.

The scale of the Longtan Hydroelectric Station project is immense, and when the normal water storage level is 400 meters, the maximum dam height is about 200 meters. The concrete gravity dam project involves 11.83 million cubic meters of earth work, emplacement of 9.3 million cubic meters of concrete, and a total investment of 3.1 billion yuan. The rockfill dam project calls for 66 million cubic meters of earth work and 34.60 million cubic meters of rockfill, emplacement of 2.49 million cubic meters of concrete and a total investment of 3.7 billion yuan. Some 55,000 mu of agricultural land will be flooded and 64,000 persons will be displaced.

In the last 20 years, the relevant departments have drawn up many plans and made many surveys and designs for the Longtan section of the Hongshui River; the Guangxi Zhuang Autonomous Region has also published a "Report on Planning for Comprehensive Utilization of the Hongshui River." Since 1978, the South Central Survey and Design office and unit No 00619 have proceeded on the basis of the Guangxi Hydroelectric Design Institute's work and have carried out a large quantity of surveys, tests and design work. In the 13 km gorge in the Longtan section between the mouth of the Buliu River and the county seat, they made comparative studies of the mouth of the Buliu River, Longtan, Macun and Liupai. Topographic and geological conditions are rather good at Longtan, the two banks are rather high and the base for the dam is middle and lower Triassic sandstone; the rock is rather strong; the sandstone's average wet pressure resistance is over 1,400 kg/cm^2, that for the shale is 600 km/cm^2, and the deformation modulus is E_0 = 15-20 x 10^4 kg/cm^2. Accordingly, although there is some slip between strata and there is a fault along the river, some slightly inclined jointing and fissuring, as well as creep of the rocks on the river bank and other geological problems, it is thought that measures can be

taken to deal with them and that a high dam can be successfully built at the Longtan embankment. In the reservoir area, the main bedrock is Triassic sandstone and shale and the sealing conditions for the reservoir basin are good; although there are limestone outcrops in several locations, the likelihood of leakage is small, and a final determination remains to be made only regarding certain underground watersheds in the diversion tunnel.

The conference participants concluded that since flood levels at the Longtan site were high, the stream bed was narrow, the geological conditions rather complex, the engineering difficulty great and the technical requirements high, further survey, design and research work should be conducted regarding the geological problems mentioned above, the high water head and large flow and flood discharge, stream diversion during construction, the large underground excavation for the power house, location of the central facilities, the crushing of rock material for the proposed large rockfill dam, waterproof materials for the dam, excavation of the high banks, measures for decreasing the quantity of excavation required, debris removal and the like.

The conference participants requested that the South Central Survey and Design Institute proceed from existing work to strengthen their surveys and studies, add to their exploratory and testing work, carry out a good economic analysis and present a feasibility report on the Longtan power station as quickly as possible, and carry out research on technical problems in a systematic manner.

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Datong Second Power Plant

Taiyuan SHANXI RIBAO in Chinese 20 Aug 81 p 2

[Article: "Touring the Construction Site of the Datong Second Power Plant"]

[Text] At the edge of Qilicun in the southern suburb of Datong city, a large modern power plant is under construction. A 70-story-high chimney points toward the blue sky and white clouds; a tower crane and portal hoist have assumed their planned positions around the main plant building, ready to lower the first hoist; huge concrete blocks are neatly stacked on the ground waiting for people to put them in place in the great cause of socialist construction--this was the scene that met us when we first saw the construction site of the Datong Second Power Plant.

At this bustling construction site, the people's work is tense and rhythmic. One only has to live here for a period of time to get the strong feeling that one is touching the powerful pulse of the four modernizations construction. In a little over 2 years, several thousand workers of the provincial First Electric Construction Company have painted a moving picture in this corner of the Datong basin.

The 210-meter chimney is currently the tallest structure in Datong city and is the pride of the building project. For this large chimney, 3,834 cubic meters of concrete was poured, and it was completed in only 2 and 1/2 months, 20 days ahead of schedule and saving 5.4 percent of the investment. No wonder people look at this

chimney and marvel at the advanced technology, rapid construction speed, low cost and high quality. Not long ago a delegation from the Mitsubishi Company in Japan said after their visit that such high-level engineering is rare even in Japan. A Chinese-American scientist put it even more emotionally; he said: "Don't think that everything in America is great, the Chinese people can create even greater things."

Indeed, this chimney was built with the sweat and blood of the workers and manifests the great ambition of the Chinese laboring class. In May 1980, when workers of the provincial First Electric Construction Company responsible for this building project heard that six sets of Chinese-made generators would be installed in this new power plant, they were greatly excited. Datong is an open city with many travelers visiting from all over the world every year. Everyone who participated in the construction project can take pride in allowing the visitors to see the great achievement of the Chinese workers class. Therefore, it is their common wish to build an advanced power plant and give credit to Chinese-made machines.

During the busy construction time, working around the clock, the workers concentrated on their jobs. In building a chimney of such a great height, difficulties are caused by the elements of nature, such as wind, rain, thunder and lightning. These natural factors were already taken into consideration in the construction organization proposal and technical planning, and appropriate measures were taken to solve the problems.

Compared to others, steel bar workers were busiest in the construction of a chimney of such height. Once a layer of concrete was poured, they had to begin working on tying steel bars immediately. The entire chimney needed 550 tons of steel reinforcement, and each bar passed through the hands of these workers. The foreman of the steel bar workers was Shen Caikang [3088 2088 1660]. Shen is in his fifties, and in the busy days of the construction he was always around the important juncture whether it was his shift or not. When the chimney was built to a height of some 20 meters, a girth truss had to be built at the throat of the chimney with 32 steel thread screws, each 8 meters long and 36 millimeters in diameter. These steel bars come with curavature and had to be threaded through a jungle of other steel reinforcements inch by inch. This was not only time-consuming but could only be done half lying down due to the restriction of the location. It was therefore the toughest job in tying steel bars. Shen volunteered for the job and the first bar took him a solid 3 hours to thread through. By the time the truss was tied up, Shen had worked 30 hours on location. When the chimney reached 100 meters, a "bull leg" was installed every 10 meters. Whenever it was "bull leg" time, you could be sure that Shen was on the job. In his own words, "there is nothing luckier than to see a modern plant being built with one's own hands." This simple honest sentence overflows with the compassion of an old worker toward our great nation. And there are many old workers like Shen at the building site of the power plant. Like him, they are all pulling for the construction of the modern power plant. In 1980, there were 1,111 staff and workers of the company rated "progressive producers and workers" of the ward or company because of their contributions.

On the building ground, the workers view engineering quality as a gauge of prestige and everyone admires the winner of an "excellent" rating. When there is a quality problem, the workers try to solve the problem on their own initiative. There is the "three no good" rule that naturally became the binding rule: leaving a snake in the grass is no good; failure to come up with a method of correction is no good; and it is no good if someone with responsibility does not get the education. The task in the second ward is to lay steel pipes for circulating water. These pipes

are rolled from 10-millimeter-thick steel plates and each section is 2.2 meters in diameter, 5 meters long and weighs 3 tons. The size of these big pipes would allow basketball giant Mu Tiezhu [4476 6993 2691] to walk through them standing up. Due to the sheer size, they cannot be guaranteed to be truly round in the forming process and it is therefore difficult to join them in the installation process. The requirement that the weld seam on the inner wall must be flat makes the welding especially difficult. In one incident, the 400-millimeter weld seam did not close and the welder added a steel bar to it. This was later discovered during self-inspection and mutual inspection of quality. Many workers regarded it as shameful and went ahead and took it apart and rewelded it. Because the workers consciously practice quality control, the acceptance rate of the 80,000 cubic meters of concrete poured by the company reached 94 percent, a record high. From January to May 1981, a total of 147 construction and installation jobs were inspected and almost 80 percent were rated good.

Engineering and technical personnel played a major role in the overall quality control. Their efforts and hard work have borne abundant fruit. In building a power plant of this magnitude, design drawings for ground construction alone numbered several tens of thousands. With that many drawings coming out of the hands of different people, various kinds of errors are unavoidable. In order to assure engineering quality, they met to go through the major engineering drawings meticulously before the construction began and discovered and corrected more than 300 problems. Meanwhile, in the technical improvement activities, engineering and technical staff and workers collaborated in achieving 93 major technical improvements and rationalizations of construction, saved 560,000 yuan, produced 52 small machines of various kinds and contributed to increasing the construction speed of the power plant. For example, in constructing the return ditch for circulating water, an integral mobile hydraulic adjustable mold was designed by the engineering technology department of the company and built by the metal structure plant. Deployment of this machine has not only increased production efficiency more than 100 percent but has also greatly reduced the amount of strenuous manual labor. According to the workers, it was a big job in the past to set, prop, dismantle and transport the mold plates. Now, by loosening a screw and turning a valve, the winch runs and automatically lifts out the mold. It is effortless and safe as well.

During the few days we were at the construction site, everyone in the company was discussing one problem: because the nation lacks financial resources, the investment allocated to the power plant this year is somewhat low (even so, the electrical system still has the highest investment among the units in Shanxi), so how can the best economic results be obtained with the small investment? Money should be spent where it counts, so where would it count most? After thinking things over, the important place is the hoisting of the plant's main building. We were told by deputy chief engineer Chen Renlong [7115 0088 7893] of the company that the emphasis of ground construction is on the No 1 and No 2 machines and the emphasis of installation is on machine No 1. This will allow the generation of electric power at an earlier date. If the hoisting of the main building could not be accomplished this year, the investments would still be spent but it would bring many problems for next year. So, after elaborate preparatory work, the hoisting of the main building began on 20 July.

The main plant building is the heart of the power plant. The heaviest of its prefabricated reinforced concrete structures weighs 116 tons, and the lighter ones weigh more than 10 tons. Just for the No 1 and No 2 machines there are about 1,000 pieces of various sizes with a total weight of 16,200 tons. On the hoisting ground, a tower hoist of 125-ton capacity and a portal hoist of 120-ton capacity are busy at work.

At dusk, high on the platform of the No 1 cooling tower, workers are still busy at their job amid the machine noise and under the flashing light. We seem to be seeing, in the near future, that strong currents are flowing through 55,000-volt superhigh voltage transmission lines heading toward the Beijing-Tianjin-Tangshan area, lighting up our great nation's capital and making it prettier than ever before.

9698
CSO: 4006/494

Shandong Industry Sees Steady Growth

Jinan DAZHONG RIBAO in Chinese 29 Sep 81 p 1

[Article: "Steady Development of Shandong's Electric Power Industry in the Midst of Readjustment. 750,000 Kilowatt Expansion in Electric Power Generating Capacity in Somewhat More Than 2 Years. Entire Province Forms a Single Electrical Grid. Plays Major Role in Assuring Electricity for Use in Industrial and Agricultural Production and for the Lives of the People"]

[Text] Shandong's electric power industry has developed steadily in the midst of readjustment of the national economy.

Under the guidance of the spirit of the Third Plenary Session of the 11th Party Central Committee, staff and workers on the electric power front in Shandong Province have liberated their mentality, and have gone all out to speed the building of electric power. At the Shiliquan, Zhanhua, and Huangdao power plants, six 125,000 kilowatt generating units of rather high efficiency have been recently built and gone into production. They have a total capacity of 750,000 kilowatts, increasing the province's generating equipment capacity by 20.4 percent as compared with the end of 1978. High temperature, high voltage electric power generating unit capacity increased from 1978's 58 percent to 71 percent. In addition 3,094 kilometers of high voltage power lines carrying more than 35 kilovolts have been erected throughout the province, and a transformer capacity of 2.96 million volt-amperes has been newly added, increasing the province's high voltage lines and transformer capacity by 23 and 27 percent respectively over the end of 1978. Zaozhuang. Linyi, and Yantai prefectures have entered the provincial electric grid one by one. In December 1980, a single electric grid for the entire province consisting of 220,000 volt ultra high voltage power transmission lines and high temperature high voltage generation units as its backbone were announced as having been formed. The construction and placement in production of these generating, transmission, and power transformer facilities has played a major role in meeting the increasing needs for electricity in agricultural production and the people's lives. In 1980, use of electricity by

the textile, paper making, and food industries was 32.9 percent greater than in 1978, and from January to August this year, it increased by another 11.6 percent over the same period last year. Electricity used for the livelihood of municipal governments throughout the province increased by 34.9 percent as compared with 1978, and between January and August this year, it increased by another 9.1 percent over the same period last year.

While hastening construction of electric power facilities, electric power industry units in the province have devoted themselves to launching a campaign of increased output and conservation, which has as its principal ingredients safety and quality, conservation of energy, and increasing economic effectiveness. They made conservation of energy, and increasing economic effectiveness. They made conservation of energy the principle tasks to be given attention in carrying out readjustment programs, enhanced electric grid economic management work, launched a general survey of thermal energy use, actively improved facilities, and strived to increase the energy utilization rate, thereby effecting substantial decreases year after year in fuel consumption standards. In 1979, in electric power plants of 6,000 kilowatts and above, 446 grams of coal were consumed for each kilowatt-hour of electricity provided, a drop of 12 grams over 1978. In 1980, the amount dropped to 434 grams, another decline of 12 grams over 1979. Between January and August this year, it fell again, this time to 426 grams, a 9 gram drop over the same period last year. In a period of somewhat more than 2 years, more than 480,000 tons of standard coal valued at more than 16 million yuan were saved. As a result of its outstanding achievements in the conservation of energy, the Shandong Province electric power industry was given the title last year of an advanced enterprise in the conservation of energy by the State Energy Commission, the State Planning Commission, and the State Economic Commission.

In the course of somewhat more than 2 years, Shandong Province's agricultural electrical enterprises also generated heartening changes. At the end of 1980, the province had somewhat more than 61,000 kilometers of high voltage electric power lines, a 24.8 percent increase over the end of 1978. It had 25 kilovolt and 10 kilovolt transformers with a capacity of 6.65 million volt-amperes, a 37 percent increase over the end of 1978. Production brigades served by electricity increased from 35.5 percent in 1978 to 43.1 percent. The area drained and irrigated by electric power expanded from 1978's more than 21.56 million mu to more than 23.88 million mu. In 1980, agriculture consumed 2.11 billion kilowatt-hours, a 45 percent increase over 1978. Between January and August this year, it increased again by 34.7 percent over the same period last year in vigorous support of the development of agricultural production. At the same time, quality of power supply throughout the province has improved greatly, equipment outages steadily declining.

9432
CSO: 4007/50

Shanxi Power Supply Good

T ...n SHANXI RIBAO in Chinese 17 Sep 81 p 1

[Article by Lu Xiaoshan [4151 2556 1472]: "Situation Good for Shanxi's Power Supply"]

[Text] From late July to mid August, the Shanxi Provincial Bureau of Electrical Industry organized 32 enterprises under its jurisdiction in the professions of electric power generation, power supply, capital construction and remodeling and building

and conducted a general cross check of the inter-plant labor competition in the first six months of 1981. The findings show a good situation of the electric industry system in Shanxi Province in the first half of this year. In February and June when the electric power demand is low, all the major economic and technological indicators are better than those of last year. "Double over-half" was achieved by the following units: Taiyuan Power Plant No 2, the Yongji Power Plant, the Shentou Power Plant, the Taiyuan Power Supply Bureau, Provincial Electric Construction Company No 3, the Provincial Institute of Electrical Power Design, the Provincial Electric Switch Plant, the Yangquan Power Plant, the Linfen Power Plant and the Changzhi Power Plant. Major economic and technological indicators have achieved the best level ever for this period of the year.

Various units of the Shanxi electric industry system have combined the economic responsibility system with the effort of strengthening ideological and political work and have obtained significant results. Paying special attention to the factional problems in the shop, members of the Party Branch at the jig tool shop of the Shanxi Provincial Electric Switch Plant went to the most troublesome teams and units to untie the knotty problems. They carried out in-depth ideological and political work, launched the movement of each party member making at least two intimate friends and created a refreshing new atmosphere at the teams and units. At the Shanxi Provincial Institute of Electric Power Design, there is a high concentration of intellectuals but the Institute leaders emphasize staff and worker training. They adopted a scheme that combines Institute-sponsored and office-sponsored activities and organized an electronics college, English and higher mathematics classes, junior and senior high school classes, and special topics workshops on hydrology, geology, surveying, computers, thermal control and drafting. More than half of all the staff and workers at the Institute participated in the training. Administration of the Provincial Electric Brake Equalizer Plant was concerned about the living conditions of the workers and first solved the housing problem for its staff and workers. Employees of this plant now average 5.5 square meters of living area and do not have to worry about housing. The Yangtong Power Company's Donghenan substation of the Lingqiu Electric Industry Bureau insisted on intelligent production and achieved the "four no's", that is, no weeds, no leakages, no category three equipment, and no accidents.

By looking into inter-plant competitions, some problems have been uncovered. For example, the problem of combining inter-plant competition and intra-plant competition, the problem of strengthening intelligent production and affirming safety-first, and the problem of inadequate solidarity in the leadership affecting work and production. Various regions participating in the inter-plant competition discussed these problems and the competition for the second half of 1981. All units are requested to make further efforts in putting various forms of the economic responsibility system on a solid basis and, taking this to be the main emphasis of the competition, strive to finish all the assignments and lay a good foundation for the yearend general evaluation.

9698
CSO: 4006/55

Shanxi Power Grids Merged

Beijing BEIJING RIBAO in Chinese 29 Sep 81 p 1

[Article: "Merging Three Power Grids--Jing-Jin-Tang, Shi-Han and Shanxi--Not Only Solves Electricity Surplus Problem in Shanxi But Also Relieves Electricity Shortage in Beijing, Tianjin and Hebei Area"]

[Text] XINHUA, 28 September: At 7 minutes past noon today, the Jing-Jin-Tang, the Shi-Han (Shijiazhuang and Handan areas in Hebei Province) and the Shanxi power grids established linkage. The three heretofore independent power grids, including the Jing-Jin-Tang grid, the Shi-Han grid and the Shanxi grid in the Hebei area, have become a single gigantic inter-provincial and intercity power grid. As a result of this linkage, not only surplus of electricity in the Shanxi grid but also the shortage of electricity in the two cities of Beijing and Tianjin and the Hebei province can be solved simultaneously.

After merging the three power grids consisting of the Jing-Jin-Tang, the Shi-Han and the Shanxi, the new power grid became the second largest power grid in China with a total installed capacity reaching 8.82 million kW. Therefore, the areas originally served by the three power grids separately can now support one another and strengthen the capability to cope with accident, and thus improve the quality and quantity of electricity supply. It has also created favorable conditions for the Huabei Electric Industry Control Bureau to implement a highly concentrated and unified management.

Shanxi Province is China's important energy base. During the process of national economic adjustment, the Shanxi Electric Power Department, with government support, speeded up construction of large-scale mine-site power plants including Shentou, Niangziguan and Hexian on the one hand, and aggressively tackled construction of new transmission lines and transformer facilities as well as developing the potential of existing old facilities on the other, and thus created the present situation of satisfying all the electricity needs of the Shanxi Province, with something left over.

Today, the Huabei Electric Industry Management Bureau is positively making plans and creating conditions to bring about as soon as possible the merging of the Hu-Bao (Hohhot and Baotou) power grid with the three power grids consisting of the Jing-Jin-Tang, the Shi-Han and the Shanxi, in order to cover the entire Huabei area with a single gigantic power grid.

9113
CSO: 4006/51

Shanxi Rural Electrification Reorganization Conference

Taiyuan SHANXI RIBAO in Chinese 9 Aug 81 p 1

[Article by Lu Hung [7627 5725] and Yang Junrui [2799 0689 3843]: "Provincial Rural Electrication Reorganization Work Conference Held in Taigu"]

[Text] Centered around "safety, conservation, raising revenue and cutting cost," the vital and urgent missions of rural electrification in Shanxi Province are the

consolidation and reorganization of the rural electric network, the improvement of the economic effects, and the supply of power to the rural consumers while maintaining the quality and quantity of electricity.

Since the Third Plenum of the 11th Party Central Committee, rural electrification in Shanxi has moved along confidently, great achievements and contributions have been made and the prospects are very good. In 1980, the agricultural power consumption was 1.806 billion kilowatt-hours and the county level industrial power consumption was 1.476 billion kilowatt-hours. These two items amount to a total of 3.282 billion kilowatt-hours, which is more than one-third of the total electric power consumption of the entire province. The agricultural power consumption is equivalent to 30 times the total electric power production in Shanxi in the early days after the revolution.

The agricultural electric power in Shanxi has progressed steadily since it came into existence. Today there are a total of 61,000 kilometers of agricultural high voltage lines (10,000 volts or higher) in Shanxi, which provide electricity to 95 percent of the communes and 76 percent of the brigades and allow them to realize the wish of "having light without burning oil."

The availability of electricity at the great majority of communes and brigades has led to big changes in the production life of the peasants. Electricity has enlarged the area of irrigated land and improved the drought-resistance ability. Although this year has seen persistent drought, electricity has insured irrigation for many communes and brigades and has led to good wheat production. The saying among the people is: "Where there is electricity, there is food."

In the development of rural electricity, many good "electricity management" experiences have been acquired by various locations; however, there are still a number of problems existing in the electrification of rural areas, such as irrational layout of electrical network, serious line losses, incompatibility and irrational use of equipment, improper attitude toward customers, low technical level and insufficient number of electricians, "large horse pulling small wagon," and electric shock accidents suffered by people and animals. In 1980 the least number of electric shock incidents was registered. Fangshan County has had no accidents in 5 years, Guangling, Zhongyang and Xingxian Counties have had no accidents in 3 years, Taigu County has been accident free for 2 years, and a number of other counties have been accident free for 100 days. However, electrocution accidents still have to be eliminated. In the first 6 months of 1981, there have already been 79 deaths in the rural areas of Shanxi. It is therefore entire necessary to carry out further consolidation of leadership organization, equipment, and management system. Through reorganization, Shanxi's rural electrification could have a rational network layout, healthy equipment and management organization, complete technical codes, and a coordinated work system. A technical team of high standard should be formed to really realize a safe supply of electric power and to improve the economic effects. This is the future of the rural electrification.

For this reason, the provincial Rural Electrification Bureau recently held a rural electrification reorganization work conference in Taigu County. Through circulation of documents, exchange of experience, and discussion of missions and institution of measures, the attending comrades agreed that, under the guidance of the spirit of the Sixth Plenum of the 11th Party Central Committee, this conference would have a pivotal effect on the future work of rural electrification. After the conference, all the participants rushed back to their respective posts and joined the new battle of establishing a job responsibility system.

8698
CSO: 4006/494

10,000 Small Hydro Plants in Guangdong

Guangzhou NANFANG RIBAO in Chinese 29 Sep 81 p 1

[Article by Sun Guohui [1327 0948 1920]: "More than 10,000 Small-scale Hydroelectric Power Plants Built in Guangdong"]

[Text] In the forum on small hydropower plant construction recently held jointly by the Provincial Energy Commission and the Provincial Bureau of Hydroelectric Power, data presented by administrative departments showed that there are new developments in small hydro construction in Guangdong Province.

According to statistics, 243 small hydropower stations were built in Guangdong in the first 8 months of 1981 and the installed capacity was increased by 73,000 kilowatts. To this point, the rural community of Guangdong Province is now in possession of 14,000 small hydropower stations with an installed capacity of 1.082 million kilowatts. This amounts to 15 percent of the installed capacity for all small hydropower station nationwide, and is the highest among all the provinces and autonomous regions. From January to August of this year, the total power production of small hydropower plants in Guangdong was 1.345 billion kilowatt-hours, which was 17.5 percent of the total electric power production in Guangdong and constitutes one of the important components of Guangdong's electric power industry.

Since the early 1970's, departments of the provincial government have put the construction of small hydropower plants on the agenda and actively assisted the electric power effort of the local units, communes and brigades from policy, capital, equipment and technology standpoints. Each year the State provides approximately 20 million yuan of aid to small hydropower plants and, more recently, there have also been 40 to 50 million yuan in loans available each year to promote the rapid development of small hydropower plants in Guangdong Province. Of the 108 counties and municipalities in the province, 102 have set up small hydropower stations and formed independent local power grids on a small scale. The installed capacities of county-operated small hydropower stations in Yangshan, Yangchun, Xinyi, Meixian, Guangning and Taishan counties are all greater than 20,000 kilowatts. With the extensive construction of small hydropower stations, electric power is provided to 96 percent of the communes, 80 percent of the brigades and 50 percent of the production teams in the province. Since 1970, Nanxiong county,

located in the northern mountainous area of the province, has built 134 small hydropower stations, with an installed capacity of 14,300 kilowatts and an annual production of 381.4 million kilowatt-hours. They have not only met their own power needs but have also supplied 10 million kilowatt-hours of electric energy to the national power grid and increased their annual income by 60,000 yuan just from electricity alone.

The small hydropower stations located throughout the province not only provide lighting for the vast urban and rural areas, and low cost power for field irrigation, agriculture byproduct processing and industries in the brigades, communes and counties, they have also accumulated capital for the local areas. In Yangshan county 200 small hydropower stations were built in a 10 year effort. From 1975 to 1980, the utilization hours of the small hydropower installations exceeded 4,000 hours every year, which is higher than the national average. The county level and commune level power stations enjoyed an average annual profit of 1.8 million yuan.

Because the development of small hydroelectric power stations is highly significant to the livelihood of the population, it has received increasing attention from the party and various levels of the government. Departments of the provincial government have regarded small hydropower station development as the direction to take in solving the rural energy problem and an important component of agricultural modernization to be incorporated into the planning of rural development. In the meantime, small hydroelectric power companies are set up in certain regions and counties to strengthen the unified management of power production, supply and usage.

The deployment of rural water resources and the construction of small hydropower stations hold a promising future for Guangdong Province. In Guangdong there are 7.38 million kilowatts of small hydroelectric power resources that can be developed, and so far only 20 percent of this has been utilized. Therefore, some of the experts in Guangdong believe that as long as the policy of "whoever builds it, owns it; whoever manages it, benefits from it" is maintained and the State and the administration continue to lend appropriate support to the rural electricity effort, that small hydropower construction in Guangdong Province has a great future.

9698
CSO: 4006/32

Xierhe Hydropower Project

Beijing SHUILI FADIAN [WATER POWER] in Chinese, No 5, 12 May 81 pp 55-57

[Article by Wang Congjin [3076 1783 6930] of the Kunming Surveying and Design Institute of the Ministry of Power Industry: "Development of the Xierhe Step Hydroelectric Power Station"]

[Text] The Xierhe Step Hydroelectric Power Station is situated on the Xier River between Changshan and Erhai near Xiaguan City in the Bai Nationality Autonomous

Prefecture in Dali, Yunnan. The power station utilizes and regulates the water of the plateau lakes -- Erhai. The natural waterfall is 610 meters divided into four steps. The method of development is by drawing water through penstocks (See Diagrams 1, 2). The total installed capacity of the power station is 255,000 kilowatts, annual generating capacity is over 1.1 billion kilowatt-hours, assured output is 110,000 kilowatts. The fourth, second and first step power stations have already been completed, the third step power station is being prepared for construction.

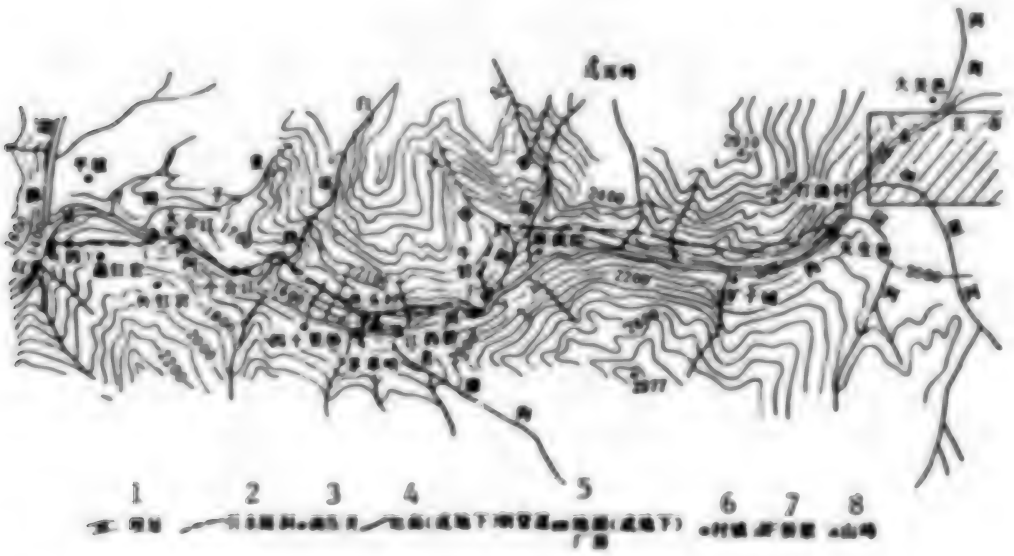


Diagram 1 Plane diagram of the step hydroelectric power stations of Xierhe

1. Dam site
2. Penstocks
3. Pressure wells
4. Ground surface (or underground) steel pipes
5. Ground surface (or underground) plant
6. Village
7. Bridge
8. Mountain peak

Diagram 2 Vertical section of Xierhe and positions of the step power stations

1. (meters)
2. Confluence of Xierhe and Yangbijiang
3. Fourth step normal water storage level
4. Third step normal water storage level
5. Second step normal water storage level
6. First step normal water storage level
7. Erhai
8. Fourth step power station
9. Dahejiang
10. Third step power station
11. Maocaoxiao
12. Second step power station
13. Niubozi
14. First step power station
15. (kilometers)

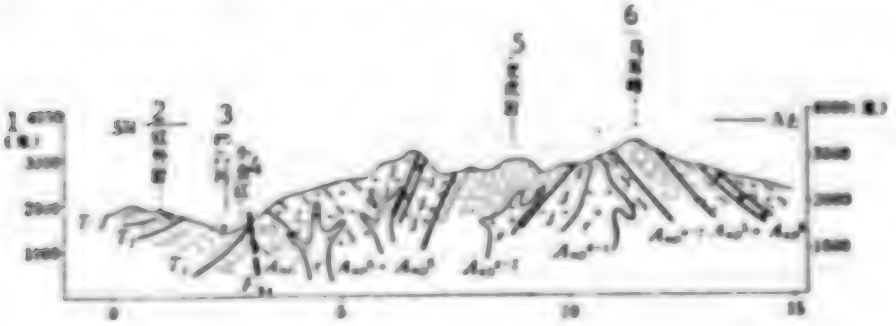
I. Natural Conditions

Xierhe is the sluice river of Erhai. It is 23 kilometers long and flows from the east to the west into Yangbijiang and belongs to the Lanchangjiang River System. The topography at the head and the tail end of the river (Xiaguan, Pingpo) is open and expansive, but the river mostly threads through deep mountain valleys and steep banks. The bedrock is exposed, water flow is rapid, the waterfalls are concentrated and they are the ideal site for building a hydrelectric power station.

Erhai, as a natural reservoir, is one of the three largest plateau lakes in Yunnan province. When the water level of the lake in ordinary years if 1,974 meters, the area of the lake surface is 350 square kilometers, total volume is 3 billion cubic meters, the exit (Xiaguan Daguanyi) controls an area of 2,470 square kilometers of the river valley. The average net flow over many years is 28.4 cubic meters/second, the annual amount of water is 900 million cubic meters.

Xierhe bypasses the southern tip of Dianchangshan, generally following the tectonic line in its development (the strike of the fault and the rock layer). Except the fourth step power station, the first, second and third step power stations are all situated on the right bank of the river, on one side of Dianchangshan. The "Dianchangshan metamorphic belt" is a fragmented and complexed compound anticline formed by the Changshan Group of the Pre-Devonian System and the metamorphic rocks of the Triassic System. The anticlinal axis extends from the north northwest to the northwest. The southern tip slants towards the south, the step power station is situated on the tip of the slant. The main tectonic line in the river valley is in the west by northwest direction. The first and second step power stations

pass through the geostrata of mixed rock gneiss and callys (AnD^5 - AnD^7) of the Changshan Group of the Pre-Devonian System. The rock formation of the third and fourth step power stations is the callys of the upper Changshan Group (AnD^7) and the shallow metamorphic phyllite, metamorphic sandstone and vitroclastic marble of the lower Triassic (T_1). In addition, the major fault of Zhemo - Yangbi (F_{64}) is almost parallel to the conduit line of the third step power station and exerts a definite effect upon construction (See Diagram 3 and Diagram 1).



1. Meters
2. Hungwaiyan
3. Sierhe
4. Xiaohe Jiang
5. Laohuyan
6. Maerfeng

[names as published]

Diagram 3 Diagram of the geological section of the southern segment of Dianchangshan to the Xierhe river valley

T - J -- purplish red sandstone, mudstone; T_2 -- limestone; T_1 -- phyllite, metamorphic sandstone mingled with vitroclastic marble; AnD^7 -- callys occasionally mingled with vitroclastic marble; AnD^6 -- greiss (with orbicular structures on the upper part); AnD^5 -- gneiss partially mingled with callys (the middle and upper parts are mingled with marble); AnD^{4-2} -- callys, granulite; AnD^{4-1} -- mixed callys; r -- pegmatite vein; F_{64} -- faults and code numbers

II. Design and Construction

The current four step development plan of Xierhe was basically determined in 1969. Its design and construction are described in general below:

(1) First step power station: This is the step power station in the uppermost reaches of the river. The dam (floor tunnel floodgate) is situated at Tianshengqiao on the edge of the Xiaguan Lake basin. The floodgate is 13.7 meters high. The reservoir (Erhai) has a normal water storage level of 1973.5 meters, operating depth is 4.5 meters, effective reservoir capacity is 1.08 billion cubic meters. The penstocks are distributed on the right side of the river. They are pressured tunnel conduits. The main tunnel is 8181.1 meters long, the diameter of the tunnel is 4.3 to 6.0 meters, the designed capacity of flow is 57 cubic meters/second. There is a double chamber pressure well and there are underground high pressure steel pipes, the slanted pipes have an incline of 35 degrees and are over 360 meters long. The plant is situated at Niubori in an underground cavern (the main and auxiliary power houses have a digging span of 18 meters, a length of 56 meters and a height of 28 meters). Inside are installed three mixed flow hydraulic turobgenerators with total capacity of 3 x 35,000 kilowatts. The fall utilized by the power station is 246.5 meters. The total amount of actual excavation for

construction (not including excavation of the first section of the river channel) is about 470,000 cubic meters, total amount of concrete used was about 188,000 cubic meters.

(2) Second step power station: The dam is situated at Niubozi -- over 100 meters down stream from the tail water of the first step power station. It is a concrete gravity dam, maximum height of the dam is 37.2 meters. The normal water storage level of the reservoir is 1,730 meters, operating depth is 10 meters, effective reservoir capacity is 200,000 cubic meters. The conduit system is located on the right bank of the river, the intake point is inside the dam on the right bank as part of the water damming structure. The intake point is connected in the rear to exposed steel reinforced concrete pipes of 22 meters long which reenter the pressure tunnel 26 meters downstream. The tunnel is 2183.8 meters long with an inner diameter of 4.3 meters. The pressure well facility has been eliminated. Instead, there are 4 sets of governing systems regulating the rate of flow and pressure valves (three sets were imported from Switzerland). High pressure steel pipes are buried 30 to 50 meters underground at an incline of 36 degrees. The power house on the ground surface is on the bank of the upper reaches of the trench at its mouth at Yitoujing. The power station utilizes a fall of 121 meters. Total installed capacity is 4 x 12,500 kilowatts. The total amount of excavation for the power station was about 170,000 cubic meters, total amount of concrete used was 84,000 cubic meters.

(3) The third step power station: This utilizes the natural waterfall of over 110 meters along the section of the river from Yitoujing to Dahe River. The dam is 230 meters downstream from the exit of the tail water canal of the second step power station. Maximum dam height is 20.7 meters. The normal water storage level of the reservoir is 1,610 meters, the lowest water level is 1605.5 meters. The intake point is on the right side of the flood discharge and scouring sluice of the upper reaches of the dam site. The tunnel on the right bank draws water. The tunnel is 3,200 meters long and its diameter is 4.3 meters. It has an impedance upper chamber pressure well. The high pressure steel pipes are exposed ground surface pipes about 950 meters long. The power house on the ground surface is on the banks of the upper reaches of Dahejiang Village. According to calculations of assured regulation, in addition to the pressure well of the power station, there are also pressure valves beside the generators.

(4) Fourth step power station: This is the step at the lowermost reaches of Xierhe. It is also the step power station that was the first to be built. It began operation in 1971, but because of evaluation of the quality of high pressure steel pipes and other problems, for a long time, it was limited to operating with only 2 generators. The dam of the power station is situated near Dahejiang Village. It is a concrete gravity dam. The dammed water rises to 19 meters. The normal water storage level of the reservoir is 1,489 cubic meters. The water conduit tunnel is on the left bank of the river. The tunnel is 1,960 meters long and the diameter is 4.3 meters. The steel pipes and the power house are both on the ground surface. The power house is situated on the beach of the left bank of Yangbijiang at the lower reaches of the mouth of Xierhe. The power station utilizes a waterfall of 122.5 meters. Total installed capacity is 4 x 12,500 kilowatts.

(3) Dredging project of the first river segment of Xierhe: The river channel from the exit of Erhai to Tianshenggiao is about 4.6 kilometers long. The river flows through Xiaguan City. Because of its small specific drop, the river bed is high, and to regulate and extract water from Erhai for generation of electricity and to drain flood water to avoid flooding, the original river channel had to be deepened and restructured. The designed total amount of dredging was about 1,300,000 cubic meters. The original plan was scheduled for completion after three years. But because of the massive amount of mud and sand (30,000 cubic meters in ordinary years, and sometimes 40,000 to 50,000 cubic meters) being brought into that segment of the river each year during the flooding period, the actual amount of dredging was larger than the designed amount of dredging. After the river channel was dredged, when the water level of Erhai was at the average water level, the depth of the water was generally over 6 meters. This is beneficial to satisfying the need for operating the power plant when the water level is at the dead water level of Erhai, it reduces the coarseness of the river and drains flood water.

III. Major Engineering and Geological Problems

During the course of constructing the power stations, many and varied hydrological and engineering and geological problems were encountered. Several major problems are briefly discussed here:

(1) Landslides in tunnels, falling of the roof and sectional supports and floor props: In the 15 kilometers of tunnels of the three power stations already built (not including access tunnels for construction), the most frequently seen were roof cave-ins while landslides of the tunnel walls and contraction and deformation of the tunnel floors occurred less. For example, at the fourth step power station, because the lithological character was softer or alternately soft and hard, because of the rich amount of underground water, and with the overly long construction period, over 30 landslides occurred inside the tunnel of nearly 2 kilometers. The accumulated length of landslides constituted about one third of the length of the tunnels. At the first and second step power stations, because the rocks were hard, the landslide segment was only one tenth the length of the tunnel. But in some local sections, because of improper construction methods, or when the intersecting angle between the fault and the tunnel line was too small and when this was handled poorly and supports were not provided in time, the landslide would enlarge until the tunnel roof slid to the ground surface (Tongtian).

(2) The problem of concentrated upsurge of water inside the tunnels: During the course of digging the tunnel chamber, when boring pierced the compressive structural surface, or when encountering marble karst caverns, a sudden and violent surge of water occurred. When dredging the exploratory tunnel for the third step power station and piercing the major fault F a large gush of water surged out from the cavern and flooded the highway. Later, during tunneling for the first step power station, similar situations were also encountered.

(3) The problem of stabilizing the side slopes: The natural mountain slopes along the ground surface power house of the second step and fourth step power stations and the steel pipe channels of the fourth step station all showed problems in the stability of the nature of the rocks and the soil layers of the side slopes. During the course of construction, they were solved by engineering measures corresponding to their geological conditions.

(4) The problem of unloading crevasses on the banks: In the region from Niubozi to Yitoucun, the rock formation slants towards the outskirts of the mountain along the slope. The rivers are seriously eroded, the unloading tension crevasses on the river banks are very developed. During arched roof dredging for the underground power house of the first step power station, 5 large crevasses were discovered, the width of the gaps were 5 to 15 centimeters, the widest reached 50 centimeters. In dredging the steel pipe channels for the second step power station, a wide distribution of crevasses was also seen.

(5) The problem of the fault fragmentation zones and soft and weak bands: One of the engineering and geological problems frequently seen in the construction of hydroelectric power stations concerns the fault fragmented zone formed by tectonic activity, interstrata compression belts, belts of concentrated joints, interformational bands formed during the course of the diagenetic process of primary rock and metamorphism, interformational contact zones, concentrated soft and weak minerals belt, secondary bands filled with crevasses and their compound products in the rock of the foundation of the dam. For example, in the gneiss of the foundation of the dam of the second step power station, three strata of 1 to 3 centimeters each (the thickest was 7 centimeters) of mud bands were discovered. During construction, spatial distribution and properties of the bands were considered and various measures of digging and removal, intercepting, filling with concrete, using anchor steel reinforcements, filling and changing the structural form of the dam, improving the itions of stress of the dam were carried out and predicted results were re d. Similar engineering treatments were carried out according to the position and the situation of the fault belt, compression belts and concentrated joints and crevasse belts encountered during basic digging for the several power stations.

(6) The problem of buried valleys, ancient river channels and deep and thick covering strata: The foundation of the dams of the third and fourth step power stations, high pressure pipes and the site of the surface power houses are all built on top of deep and thick alluvium and diluvium. There are also more buried valleys and ancient river channels in the river valleys and these have brought about a lot of trouble for basic dredging.

IV. Construction

The construction schedules of the step power stations on Xierhe were as follows. The fourth step power station began construction in 1958, construction ceased in 1961, restarted in 1966, and the power plant began operating in 1971. The second and first step power stations were completed in 1978 and 1979 respectively and have joined the network to transmit power. The third step power station is about to begin construction after a period of preparation. During the construction period of the hydroelectric power station projects, the latter period construction of the tunnels of the first step power station utilized plain surface demolition, blown anchor supports, floor arch sliding forms and mixing concrete additives and such new techniques. To accumulate data, train personnel, strengthen scientific research work, stress measurements of the rocks of the tunnels were taken, and sound waves were used to measure the relaxation zone of the wallrock and the completion coefficient, concrete was sprayed to line the tunnels, water pressure experiments were conducted, the original form of the tunnel chambers was observed. During the course of tunneling for the first step power station, research and experiment of the domestically produced SJG-53-12 model and the SJ58 model tunnelers were conducted.

The diameter of the SJ58 model tunneler is 5.8 meters, it tunneled the whole cross section and reached a highest monthly tunneling speed of 50 meters. The SJG-53-1 model tunneler tunneled a tunnel of 5.3 meters, and the highest speed per shift was 4.55 meters. The entire experiment showed that although some problems still exist in continued tunneling and cutting tools, it has provided first hand information for further improvements, popularization and application. In dredging river channels, the 90 cubic meters/hour hydraulic absorption mud pumping vessel, the 120 cubic meters/hour chained bucket type dredging vessel and the 120 cubic meters/hour chained shovel dredger were used jointly and a definite experience was gained. In addition, the second step power station "used valves in place of wells" as pressure regulators for the water drawing type hydroelectric power station and realized success. The crescent moon shaped high pressure fork tube experiment, manufacturing and installation at the first step power station have all provided new experience in the building of hydroelectricity.

At present, scientific research and experiments in construction using the "Newall system" are being grasped tightly because of the poor geological conditions of the water penstocks of the third step power station being prepared for construction. It can be foreseen that on the practical foundations of projects already built, the third step power station will surely hasten its construction and realization of the task of total development of the Xierhe step power stations is not far away.

9296
CSO: 4006/478

Experts Fight Longyangxia Floods

Beijing GUANGMING RIBAO in Chinese 12 Oct 81 p 1

[Article by reporters Ma Jiqi [7456 7162 3823] and Yang Liben [2799 4539 2609]]

[Text] When an extraordinarily large flood in the upper reaches of the Huanghe in September this year, threatened people's lives and property, hydropower experts came from around the nation to Longyangxia to fight the flood and immediately engaged themselves in a tense battle. They went back and forth between the flood site and their offices, making observations and scientific calculations and analyses in turn, and thus contributed positively toward flood fighting by suggesting plans and measures.

In the afternoon of 6 September, the Ministry of Electric Power received an emergency report concerning the rapidly rising water level of the Longyangxia reservoir.

A 64-year old expert, Li Eding [2621 7725 7844], vice-chairman of the International Dam Committee and deputy director of the Chinese Society of Hydropower Engineering, arrived at Longyangxia on 8 September. He inspected the situation, braving heavy rains to analyze the meteorological and hydrological conditions and study the conditions of a temporary effluent barrier. He suggested that the surrounding earth embankment be made higher and reinforced to combat this extraordinarily large flood. At the same time, he advised the Qinhai Provincial Party Committee member to evacuate the residents in a five-county area including Guide county, situated in the vicinity downstream of the reservoir. In more than fortnight of fighting the

flood, although suffering from a heart condition and diabetes, he went up and down a small path more than 300 steps long on the face of a cliff 100 meters high, inspecting the flood situation from the top of the embankment and directing the battle against the flood. One day, while standing on a suspension bridge over the valley investigating the flood's water-flow situation, he noticed a huge rock on top of the cliff above an earth embankment. He thought: if this rock were to slide down the cliff, it could destroy the flood overflow route. He immediately ordered the members of engineering bureau to remove the rock. During the most tense hours, he worked day and night without a break, analyzing the flood situation scientifically and making a series of suggestions concerning the flood fighting measures.

The military as well as the civilians residing in the Longyangxia work district praised Pan Jiazheng [3382 1367 6727], a member of Academic Committee, Chinese Academy of Sciences and the deputy chief engineer of the State Bureau of Hydropower Construction, Ministry of Electric Power, for his contribution toward fighting the flood. In July this year, this famous expert in the field of computational theory of hydraulic structures came to Longyangxia and rechecked by calculation the structural soundness of the surrounding earth embankment and the construction of emergency flood overflow route, focusing on a probable flood situation. According to his proposals based on the calculation, the Fourth Engineering Bureau of the Ministry of Electric Power reinforced and raised the height of the surrounding embankment three meters with rocks, and the slope facing the water was tightly packed with wire mesh cages and reinforced with concrete. They did a great deal of preparatory work to combat the great flood.

On 12 September, when the flood situation was very tense, Pan Jiazheng hastened to the work area again. At that time, the volume of flood water influx was more than 5,570 m^3/sec, and the water level was rising at the rate of 0.1 m/hr, applying ever greater pressure on the embankment. Everyone became very nervous. He went to the top of embankment in person to inspect the readings of more than 40 instruments buried inside the embankment. He did theoretical calculations to check the stability of the entire embankment, the stress in the central wall and the sidewall structure of the flood overflow route. According to the scientific design, he proposed plans to reinforce and increase the height of the surrounding embankment. During the course of flood fighting, the reinforcement works of a large number of structures were done entirely according to his proposals.

In the decisive battle to protect the embankment from the flood water, the experts, the military, and the civilians fought side-by-side, sweating profusely. Sixty-three-year old Yang Yang Chungui, deputy chief engineer of the State Bureau of Hydropower Construction, arrived at the site on 8 September and insisted on working on the site every day. On the 15th, a waterhead as powerful as a waterfall formed a gigantic swirl on the left side near the exit of the flood overflow route, violently cutting at the embankment wall. The rocks and huge cement blocks protecting the slope crumbled one after another, and the surrounding embankment was dangerously threatened. At 7 o'clock in the evening, Yang Chungui hastened to the site to inspect the swirl, standing on a cement block 4 meters high at the edge of the slope and risking his life, while the flood water surged violantly at his body. He suggested instantly an emergency measure that straw bags filled with concrete be pilled up at the base of the slope as a wall to break the water. He worked with the workers until 2 o'clock in the morning. On that day, he worked continuously for 14 hours and climbed the small path leading to the embankment three times.

9113
CSO: 4006/51

Briefs

SHENTOU-YUCI LINE--The construction project of rebuilding the second 220 kilovolt transmission line from Shentou power plant to Yuci substation was completed on 25 July, 5 days ahead of schedule, and the test run began officially at 1:38 am on 30 September. The length of the second Shentou-Yuci transmission line is 210 kilometers and there are 625 steel towers and concrete posts along the way. This transmission line passes through some steep mountainous area. The workers endured great hardship and the quality of the installation meets the regulation standard completely. [By Sun Huiquan [1327 1979 3123] and Zhang Xuanyi [1728 1357 5030] [Text] [Taiyuan SHANXI RIBAO in Chinese 1 Oct 81 p 2] 9698

ELECTRIF'ED RAILWAY LINE--Since the opening of the Shijizhuang-Yangquan electrified railway, it has been running safely and on-time and the transportation capacity has increased 300 percent. This electric powered railroad was completed in August, 1980 and since it opened for traffic, the hauling tonnage, running speed and frequency of the trains have all increased. The trains are used to be pulled by steam automotives which can only pull 800 tons with a speed of 23 kilometers per hour. Now each automotive can pull 1900 tons at a speed of 34 kilometers per hour. They have guaranteed the coal transportation for Yangquan, Pingding, Xiyang, and Yuxian. [by Han Zhongxiao [7281 1813 1321] and Xie Zhangming [6200 7022 0730]. [Text] [Taiyuan SHANXI RIBAO in Chinese 1 Oct 81 p 2] 9698

CSO: 4006/65

HYDROELECTRIC POWER STATIONS--Beijing, 3 Nov (XINHUA)--China built 1,600 small hydroelectric power stations in the first nine months this year, adding to the total generating capacity by another 400,000 kilowatts, the PEOPLE'S DAILY reports today. China's rural areas now have more than 90,000 small hydroelectric power stations with an aggregate generating capacity of 7.33 million kilowatts, one-third of the country's total hydroelectric power generating capacity, the paper says. These small power stations turned out a total power output of 8,300 million kilowatt-hours during the January-September period. Now the country's 748 counties, about one-third of the total, 17,000 people's communes and nearly 100,000 production brigades depend mainly on the small local power station for electricity. [Text] [Beijing XINHUA in English 1218 GMT 3 Nov 81 OW]

CSO: 4020/33

GUANGDONG HYDROELECTRIC CONSTRUCTION FORUM--The Guangdong Provincial Energy Conservation Committee and the Provincial Hydroelectric Power Department recently held a forum on 28 September. The forum has provided evidence to prove that Guangdong Province has achieved greater development in the small hydroelectric power industry. In the first 8 months of this year, the province completed construction of 243 small hydroelectric plants, increasing the installed capacity by 73,000 kilowatts. To date, there are altogether 14,000 small hydroelectric power stations in the rural areas in Guangdong Province, and the total installed apacity amounts to 1.082 billion kilowatts which represent 15 percent of the total installed capacity of small hydroelectric power stations throughout the county. Small hydroelectric power stations have been built in 102 out of 108 counties and municipalities in the province. [Guangzhou Guangdong Provincial Service in Mandarin 2300 GMT 28 Sep 81 HK]

CSO: 4006/71

GUANGXI HYDROPOWER RESOURCES--Naning, 22 Sep (XINHUA)--The Guangxi Zhuang autonomous region in South China has an estimated potential of 17.51 million kilowatts of waterpower resources, 16.75 million kilowatts of which can be exploited, 95 percent of the total, according to surveys by the region's department of water conservancy and power industry. Guangxi's annual rainfall ranges from 1,100 to 2,800 millimeters. There are 937 rivers in the region. Ten big power stations with a total generating capacity of 12.9 million kilowatts can be built on the upper reaches of the Hongshui River, which has the region's largest waterpower resources. So far Guangxi has built hydroelectric power stations with a total generating capacity of 1.19 million kilowatts. [Text] [Beijing XINHUA in English 1241 GMT 22 Sep 81 OW]

CSO: 4020/9

HAINAN'S HYDROELECTRIC POWER STATIONS--During the 5 year period from 1976 to 1980, Hainan Island established a total of 246 medium and small hydroelectric power stations, with a total generating capacity of 102,000 kilowatts. The amount of electricity generated in 1980 reached 400 million kilowatt-hours. At present, some 3,700 kilometers of high-tension electric cables have been erected. As a result, 92 percent of the communes and 56 percent of the brigades on Hainan Island now have electric power supply. [Guangzhou Guangdong Provincial Service in Mandarin 2300 GMT 30 Aug 81 HK]

CSO: 4006/36

HEBEI RURAL ELECTRICITY SUPPLY--Electricity supply in the rural areas has been developed greatly in Hebei Province over the past few years. As of 31 August this year, electricity supply is available in all the counties in the province except Guyuan County, and in 86 percent of the communes and 91 percent of the brigades. In the first 8 months of this year, electricity consumption in the rural areas increased by over 410 million kilowatt-hours over the corresponding period last

year. In the wake of the development of the national economy and improvement of the people's standard of living, there are growing demands for electricity. In light of this, the provincial electricity supply bureau has improved electric power supply in the rural areas by repairing and rectifying the electricity network in the rural areas. [Shijiazhuang Hebei Provincial Service in Mandarin 0400 GMT 28 Sep 81 HK]

CSO: 4006/71

JILIN POWER CONFERENCE--The provincial electric power work conference opened 29 October. Attending were responsible persons of the municipal, prefectural, autonomous prefectural and county economic commissions and electric power departments and bureaus and of provincial level departments concerned, as well as responsible persons from enterprises. (Li Zhenjiang), deputy governor, attended and addressed the conference. The conference disclosed that power output and supplies have been good since the beginning of 1981. During the January-September period, power output increased 13.2 percent over the corresponding 1980 period. Power supplies can satisfy the province's economic readjustment and the needs of the people in 1981. [Changchun Jilin Provincial Service in Mandarin 1100 GMT 30 Oct 81 SK]

CSO: 4006/130

NEI MONGGOL POWER OUTPUT--Hulun Buir league's power departments had generated 125 million kWh of electricity by the end of September, an increase of 22.46 percent over the corresponding 1980 period. These power departments earned an income of 11.8 million yuan, 18 percent better than the corresponding 1980 period. [Hohhot Nei Monggol Regional Service in Mandarin 1100 GMT 30 Oct 81 SK]

CSO: 4006/130

SHANDONG POWER INDUSTRY--The power industry in Shandong Province has been successful in implementing contract and profit-sharing systems and in promoting ideological work. As a result, production has developed rapidly. The provincie's power output in the first 9 months of 1981 increased 4 percent over the corresponding 1980 period. Losses of electricity on transmission decreased by 10 million kWh. During the 9 months, the province's power industry made a profit of 288.8 million yuan. [Jinan Shandong Provincial Service in Mandarin 2300 GMT 29 Oct 81 SK]

CSO: 4006/130

ZHEJIANG PROVINCIAL POWER AMALGAMATION--Hangzhou, 13 Sep (XINHUA)--With the approval of the Ministry of Power Industry, Zhejiang's provincewide merger of power enterprises was recently achieved. First ever in such undertaking, the merger involves 14 power generation plants, 8 prefectural power bureaus and 44 county power companies of the province. The merger is under unified management and is expected to contribute to energy conservation and greater economic results. [Beijing XINHUA Domestic Service in Chinese 0018 GMT 13 Sep 81 OW]

CSO: 4006/36

NORTHEAST POWER CAPACITY--The power network in west Heilongjiang, including the Qiqihar and Daqing areas, was incorporated in the main power network of northeast China, including Liaoning, Jilin, Heilongjiang and Nei Monggol, on 30 October to increase the power capacity, facilitate the power supply and management and reduce inconveniences in west Heilongjiang. [Shenyang Liaoning Provincial Service in Mandarin 1100 GMT 31 Oct 81 SK]

CSO: 4006/130

DEVELOPMENTS, APPLICATIONS IN SOLAR ENERGY

Joint Cooperation Needed

Beijing GUANGMING RIBAO in Chinese 24 Oct 81 p 1

[Article by reporter Lu Liang [4151 5328]: "China's Solar Energy Scientific Researchers Suggest That Joint Cooperation Is Needed in Use of Solar Energy"]

[Text] More than 200 experts, professors, and technical personnel who attended an annual conference of Chinese Society for Solar Energy which was concluded recently in Hangzhou considered that the key to rapid development and utilization of solar energy consists of joint cooperation, stronger leadership, unified coordination, divided work cooperation and competition.

In recent years, there were a number of problems concerning scientific research, production, and popularization of solar energy utilization. The major one among these problems was scientific research on solar energy utilization. The technical forces were weak and scattered and the research works were uncoordinated, so that there were many duplications. This situation did not help the development of solar energy utilization. The experts who attended the conference suggested that the concerned leading department should treat solar energy utilization as one of the important projects related to China's energy resources study and strengthen leadership on this subject. At present, a unified system consisting of scientific research, popularization demonstration and production must be established first, then a special enterprise dealing with solar energy utilization may be built step-by-step. The concerned department should, taking into consideration the existing force and facilities, make an overall and unified plan and organization. It should selectively support the superior, distinguish between good and bad, and emphasize priorities and promote division of work and cooperation. The experts further suggested that we must take advantage of the outstanding individual feature of scientific research units, educational units, and production units, and make best use of them all. The scientific research units should concentrate on the utilization of solar energy, with some basic theoretical research. The educational institutions should emphasize basic theoretical research, and the production units should emphasize improvement of technology and quality and reduction of costs.

The experts proposed that we must quickly organize our forces and launch an allout assault on various problems related to scientific research, production, popularization and even technology in order to achieve breakthrough. Hot water heaters and furnaces ought to be designed jointly by the concerned units and manufactured by a few select plants according to specific standards.

9113
CSO: 4006/66

Creation of Specialized Units

Beijing RENMIN RIBAO in Chinese 16 Aug 81 p 5

[Article by Beijing Municipal Solar Energy Research Institute: "Accelerating the Use of Solar Energy"]

[Text] In this letter we shall briefly discuss the utilization of solar energy and express some of our opinions.

From the long-term point of view, energy resources such as coal, oil and natural gas all have a finite reserve and will eventually run out. On the other hand, solar and nuclear energy will be the reliable energy sources for the human race.

China has an immense territory and abundant solar energy resources, two thirds of China have more than 2000 hours of sunshine per year. Way back in the 1950's China begun its research on the solar furnace, the solar hot water heater and solar cells. Today, the collecting area of solar hot water heaters in China has reached 100,000 square meters and the scope of application is gradually growing. There are about 2,000 solar furnaces in use at various places, most of them are of the parabolic focusing type. They have partially solved the serious shortage of fuel in some rural and remote areas. In addition, research and application of the passive solar house, solar drying devices and solar distillers have also made progress.

Every since silicon solar cell electrical system was successfully used in China's first satellite in 1971, the quality of solar cells has continued to improve and the cost has gradually decreased, applications of solar cell on the ground is broadening. Solar cell devices such as navigation light, railroad signal system and electric fence have played a role and the results are satisfactory.

According to statistics, 150 units and more than 1000 specialists and technicians in China are engaged in solar energy research and application. The China Solar Energy Society, established in 1979, has published popular science magazines and academic journals on solar energy. Academic exchange activities between China and foreign countries are also on the rise. Today there are two opposite views on solar energy. One view is that since the technology of solar energy application is still not mature, the economy of solar energy is poor, the energy density is low and elaborate facilities are required for its application, and the usage of solar energy is limited due to the alternations of day and night and the change of seasons, solar energy is an energy source for the future and should not be developed at the present time. The opposite view is that the sun is an immense and clean source of energy with many advantages and should be developed and used on a large scale immediately.

Both views are one-sided. If one looks at the history of energy development, it always takes a long transition period for a new energy source to replace an old one. Chinese history mentions the use of coal more than 2000 years ago, yet extensive use of coal as an energy source occurred only in the past few hundred years. It took almost half a century from the discovery of nuclear energy to its actual application and it is still not widely used today. Large-scale deployment of solar energy will also require some long and tedious work of research and development and

demonstration and promotion. On the other hand, one should not wait until the regular energy sources of coal and oil are about to run out and then "start digging a well when one is beginning to feel thirsty." There will be energy shortages in China in the 1980's. With all the professions searching for substitute and supplemental energy sources, small-scale application of solar energy is imminent.

The economic and technical aspects of solar energy application are relative. Although some devices using solar energy require a large one-time investment, the traditional energy resource and manpower it saves and the reduction in environmental pollution are hard to estimate. In some remote areas, fuel is in very short supply; in order to solve people's food and drink problems, certain areas had to burn precious trees as fuel. In some places in Xinjiang, people cook once a week and eat dry cereal the rest of the time. Fuel for resident living is also very tight in Tibet and Qinghai. But these places have abundant solar energy, why not use it? Besides, the technology for solar hot water heaters and solar furnaces is well known and such devices are economically competitive and they are completely ready for wide use. As for the disadvantages of interrupted and diffused availability, they can be overcome with integrated use of multiple energy sources. For example, combined use of solar energy and methane is a good option.

Solar energy application should be supported and encouraged. Based on their own national interest, many countries in the world are giving their solar energy industry and users economic benefits. But the promotion of solar energy application in China is hindered because some of the economic policies are less than rational. For instance, if a barber shop installs a solar hot water heater, it is considered a capital item and depreciation fees are assessed even in winter when the item is not in use. This practice decreases the income of the enterprise and some units would rather let the device go unrepaired than use it. It is of course difficult for the State to provide general subsidy for solar energy but considerations should still be given to tax waiver for technologically mature solar energy products. Loan or installment for solar energy users and solar energy supplementations for areas of fuel shortage should also be considered.

Solar energy is highly interdisciplinary and involves many scientific fields and professions; therefore, there should be an overall planning to avoid blind efforts and the coordination between scientific research, production and promotion must be done well. At present, work in this area is very inadequate. For example, in the case of the fast-developing solar hot water heater, there is still no unified regulation on its material, production, quality, price, specification and application. As a result, there have been some confusion and waste and the promotion of new technology and new products is very slow. We suggest that specialized organizations, such as solar energy industrial companies, be established in areas that are in a position to do so in order to carry out unified management, set standards and codes and put them into practice.

9698
CSO: 4006/31

Good Results Around Nation

Beijing GUANGMING RIBAO in Chinese 24 Oct 81 p 1

[Article: "Good Results in Use of Solar Energy Around the Nation"]

[Text] Good practical results have been achieved in many fields in relation to the utilization of solar energy around the nation.

Today, there are more than 30 factories in 15 provinces and cities in China where various types of solar energy water heaters are manufactured. The annual output is up to 50,000 square meters, and there are more than 100,000 square meters of solar energy water heaters being utilized nationwide. Each square meter can save 200-300 kg of coal a year. There are more than 5,000 square meters of solar energy water heaters used in Shanghai alone, substituting the coal-burning furnaces and supplying hot water for a number of governmental and private organizations. These solar energy water heaters can save approximately 1,500 tons of coal for the city of Shanghai this year. A solar energy hot water heater built in Daxing County in the suburbs of Beijing can supply hot bath water for 15,000 persons a day.

According to a study, there are more than 10,000 solar furnaces owned and utilized by the villages in various parts of the country, and members of communes in more than 20 provinces, cities and autonomous districts are known to be users of solar furnaces.

Good results from research on the utilization of solar energy have been achieved in various other areas also. The Shanghai Energy Resources Office and the Baoshangu Village Grain Control Office have jointly developed and constructed a solar energy collector having an area of 32 square meters and a volume of 27 cubic meters. Under normal sunlight conditions, it can dry 400 jins of noodles in only 4 hours. The Shanghai Xinhua Light Fixtures Plant has, in cooperation with concerned units, developed and manufactured 21 products of 16 different kinds including a silicon solar energy black-light lamp and a rubber tapping lamp. These products are being utilized by industry, agriculture, animal husbandry, national defense, navigation and medicine nationwide in 21 provinces, cities and autonomous districts. Shanghai No 2 Smelting Plant utilized the single crystalline silicon rejected by the plant and assembled various types of solar energy cells with power ratings as high as 5 kW. These cells are widely being utilized by the railroad system, seismic stations, weather stations, and for illumination purposes in the remote areas where no conventional energy sources are unavailable. China's largest 720 watt solar cell, which is installed at the Ketu railroad station on the Xizang Plateau, provides power for illumination and railroad communications in the remote mountainous area where no electricity is available, and thus has opened up a wide and bright prospect for the area. A solar energy vegetable green house was built at Xining, Xizang, and a way has been shown to solve the problems related to vegetable production during the winter months on the cold highland. Xizang has further manufactured many other types of products including solar energy electrified fences, solar energy illuminating lamps, solar energy portable lamps, solar energy cells for transister radios, solar energy cells for seismic stations, solar energy chargers for triple-flash cameras, solar energy cells for artillery applications, and solar energy cells for railroad signals.

9113
CSO: 4006/66

Full Utilization in Yunnan

Kunming YUNNAN RIBAO in Chinese 5 Aug 81 p 3

[Article by Zhang Haiping [1728 3189 1627]: "Fully Utilize Solar Energy -- Our Province Has Unique Conditions To Utilize Solar Energy"]

[Text] Utilization of solar energy by man is not a thing of the past 10 or 20 years. It began from the time human beings came into existence. At that time, the use of solar energy by human beings was unconscious and indirect. For example, plants absorbed sunlight and grew, people ate the fruits of plants, used plant fibers to make cloth, and that was it.

Cases of conscious and direct use of solar energy by human beings occurred over 3,000 years ago during our nation's Western Zhou period when the use of sun flints to make fire was invented. The so-called sun flints were concave mirrors. The use of concave mirrors to focus sunlight to light moxa was an advance from drilling wood to make fire and the significance was profound and far reaching. As Engels said, this was "the first time that man controlled a natural force, thus finally separating man from the animal world."

Solar energy occupies an especially important position in the various energies of nature. It is clean, it is massive, and it is durable. The sun is in its "youth", it still has several billion years until its demise. Coal, petroleum and natural gas which are now used as the major energy sources also come from solar energy. Ancient biological sediments slowly form coal, petroleum and natural gas under ground, thus the energy of living beings is formed by the conversion of solar energy via photosynthesis. Therefore, coal, petroleum and natural gas can be said to be the solar energy of the past that has been stored. Although a massive amount of solar energy has been stored over a long period of time, it cannot withstand human consumption. At present, world consumption of energy increases 5 percent a year, and it is estimated that after 20 years, petroleum and natural gas will be exhausted and the shadow of an energy crisis is looming over the head of mankind.

Hydroenergy, wind energy and solar energy seem to be unrelated, but in fact, they are all variations of solar energy. This is because the sun evaporates moisture causing the water level to rise and to possess energy, and the sun heats air to create differences in atmospheric pressure which forms wind. Therefore, the utilization of hydroenergy and wind energy is the utilization of solar energy, but it is only an indirect utilization.

The massive use of coal, petroleum and natural gas has also brought about serious pollution, greatly worsening our living environment and affecting human health. Uncontrolled felling of forests for firewood has caused the loss of water and soil and destruction of the ecological balance. Solar energy does not have such shortcomings: it will not cause any pollution, it is available everywhere, and it does not need to be transported.

The sun delivers 80,000 billion kilowatts of energy to the earth each second. If all this energy is converted to electricity, it will be many ten thousand times

more than the amount of electric power generated by the world. But, the amount being utilized now is very small, and most of it is wasted. The study of highly efficient direct utilization of solar energy is the goal which scientists of every nation are struggling to realize. At present, direct utilization of solar energy is realized in three ways:

Converting light energy into thermal energy. The installations utilized are mostly flat board or focusing heat collectors. The heat collector contains water. The water heated by the sun can be used for bathing. The installations that utilize parabolic mirrors to reflect sunlight and focus sunlight on one point and creating a high temperature of from 400 to 650 degrees centigrade are used for cooking. These are solar stoves. The principle of conversion is simple, it is easy to popularize, and it is the most successful method of utilization at present. The shortcoming is that the cost is high and the efficiency of energy conversion is low.

Converting light energy to electrical energy. Photoelectric cells that generate electricity have been manufactured by utilizing the phenomenon of certain materials that will produce an electric current when subjected to light (photoelectric effect). Photoelectric cells are presently widely used in artificial satellites and spacecraft, utilizaton on the ground is limited to unmanned beacons, lamps of navigation marks, high class watches, black lamps used in agriculture and such special situations. Large-scale utilization is possible only after the problem of high costs is solved.

Converting light energy into chemical energy. Photosynthesis in green plants is this type of conversion. This type of conversion is common in nature, it is the major and the most fundamental method of direct utilization of solar energy. Yet, compared to the previous two types of conversion, this type of conversion cannot be completely controlled by man. Scientists are studying in depth the mechanism of photosynthesis. As soon as it is clearly understood, man will be able to simulate photosynthesis to produce food grains and fuel. By that time, only water and carbon dioxide are sent into the "green factory" but what comes out will be rice, bread, fruits, vegetables and oxygen. Of course, this is a relatively distant thing, at present, the method being used is the utilization of solar energy to cultivate fast growing trees as fuel, massive cultivation of algae, and then let the algae ferment to obtain fuel.

Our province has unique conditions for the utilization of solar energy. One is the low latitude. Because the latitude is low, sunshine is strong. In the same area and over the same time, the intensity of sunshine at 30 degrees north latitude is 1.7 times the intensity of sunshine at 60 degrees north latitude. Kunming is at 25 degrees north latitude. The intensity of sunshine is very strong. The second is the high altitude. The higher the altitude above sea level, the stronger the sunshine. The reason is that when sunshine passes through the atmosphere, a part is absorbed, a part is scattered, so that the sunshine that shines through is weakened. The transparency of the atmosphere on the Yunnan Plateau is high, attenuation is small. The third is that there are more days of sunshine and the duration of sunshine is long. Take Kunming as an example. The annual average duration of sunshine is 2,527 hours and except for the rainy season from May to August, the remaining days are almost all sunny days. The fourth is that the

annual temperature difference is small and the temperature of the environment is high. We can fully develop the rich and superior solar energy in our province to utilize solar energy in the cities and in the broad number of farm villages to heat water, for cooking, drying, distilling and all other possible uses. Kunming Railroad Bureau's Materials Plant has a heat collector with a light gathering surface of 56 square meters. On sunny days, it can serve the needs of over 100 people to take baths, conserving 30 tons of coal a year and 5,400 kilowatt-hours of electricity and 2,300 yuan in expenses. Practice proves utilizing solar energy has many benefits and it is not difficult to realize.

With the emphasis placed on it by the leadership at each level and the efforts of scientific and technical personnel, utilization of solar energy will produce results throughout our province.

9296
CSO: 4006/499

Use in Shanghai

Beijing TAIYANGNENG [SOLAR ENERGY] in Chinese No 3, 1981 p24

[Article by Zhu Chengming [2612 2052 0682]: "A Brief Description of Solar Energy Use in Shanghai"]

[Text] There are already more than 300 persons in Changhai specializing in solar energy research.

The Shanghai Solar Energy Society was created in June 1980, and now has more than 200 members.

The total solar collector area for water heating in the city is more than 5,000 square meters; a large proportion of this area consists of flat-plate, flat-tube design of the Shanghai Industrial Construction Design Institute. As of November 1980, the solar water heating equipment plant in Chanbei Ward, Shanghai City, had produced 3,700 square meters of water heating solar collectors.

The PH-1 plastic-tube solar water heating collector developed by the Shanghai Municipal Inland Water Transport Office and other units has a heating efficiency of 60 to 65 percent, and is now coming into more extensive use.

The Shanghai Institute of Silicates, Chinese Academy of Sciences, together with the Shanghai Medical Glass Combine and the Shanghai No 5 Enamel Plant, is developing high, medium and low temperature evacuated glass tubes and enameled heat collectors preparatory to fixing the design and putting them into production; research is also continuing on the "two in one" solar heater which is built into the roof surface.

There are still a few corrugated and shallow-pool water heating collectors.

The focusing solar oven developed by the Shanghai No 15 radio plant, the automatic tracking high-temperature solar oven (diameter 5 m) experimentally produced by Shangfeng Middle School, Shanghai, the drying apparatus and high-temperature oven developed by the Shanghai Construction Equipment Plant, and the air heater developed by the Shanghai Steam Fittings Plant have all been submitted to the Shanghai Muni-

cipal Energy Utilization Technology Research Institute, and improvements are continuing.

The Shanghai No 1 National Cotton Plant has developed a forced-circulation air collector which is used in drying textile machine parts and can save 15,000 kilowatts of electricity a year.

The Shanghai Mechanical Engineering Society's Solar Energy Research Institute has installed a set of experimental solar generating equipment rated at 1,000 kilowatts, and has carried out research on solar water pumps, air conditioning, heating and collectors. In 1980 it began recruiting solar energy research fellows, and together with the Shanghai Municipal Solar Energy Soviety it has held short courses in "Solar Energy Conversion Engineering," and "Solar Water Heating Equipment Test Standards."

The total power of solar electric power generating equipment citywide is more than 15,000 watts. It includes the 9,300-watt Xinhua Lamp Plant installation, the country's first large-scale solar-powered lighthouse, installed by the Shanghai Navigation Beacons Plant, the large-size solar powered quartz electronic clock test-produced by the Shanghai No 4 Watch Factory, the country's first lot of solar-powered wristwatches, developed by the Shanghai Light Industry Research Institute, and the focusing-type solar cell array developed by the Shanghai Xinyu Power Supply Plant and the Shanghai Xinhua Lamp Plant. Shanghai-produced solar cells are also in extensive use with agricultural ultraviolet lights, rubber-tapping lamps, electric fences, seismograph, rain gauges, soil testing instruments, lighting, railway signal lights, color television differential rotators, walkie-talkies, calculators, lighters, surgeon's headlamps and navigation lights, among other uses.

The Shanghai Research Institute of Nonferrous Metals, the Shanghai Metallurgical Institute, Chinese Academy of Sciences, the Shanghai Research Institute of Silicates, Shanghai Communications College and Shanghai Scientific and Technical College are developing cadmium sulfide, gallium arsenide, photoelectronchemical, noncrystalline silicon, cast polycrystalline silicon and other types of solar cells.

With the joint efforts of the relevant organizations, Shanghai has also developed a rubber belt type reflecting material (polyamide with a vacuum-deposited alimunum film).

The Shanghai Institute of Silicates, CAS, is carrying out research on selective coatings, basic materials for thermoelectric conversion and other topics and has developed a portable solar absorptivity measuring device and a small, fast emissivity measuring device.

The Nanhui County Agricultural Science Research Institute is test-producing a solar seed breeding unit and has carried out experiments on the use of irradiation in seed breeding.

The Changhai Municipal Energy Utilization Technology Institute is an organization which focuses on energy conservation and solar energy; it now has more than 20 persons engaged in scientific research on the utilization of solar energy, and is currently studying such topics as solar ovens, solar water heaters, reflective materials for solar uses, and cadmium sulfide solar cells.

8480
CSO: 4006/9

Solar Building in Quanji, Qinghai

Beijing TAIYANGNENG [SOLAR ENERGY] in Chinese No 3, 1981 pp 6-7

[Article by Zheng Minzhang [6776 2404 2874]: "Three Visits to the Quansi Solar Building"]

[Text] Quanji is on the northwest shore of Qinghai Lake and is the location of a commune in Gangcha County, Qinghai Province. This is an extensive, sparsely populated territory without an electrical network, and with little wood or straw. Cow manure is burned for fuel, and coal must be hauled more than 200 kilometers. However, there is an eye-opening solar house here. In the last year I have visited the Quanji solar building three times and have become inseparably tied to it. When I think of Quanji's brilliant sun, of the springlike atmosphere inside the solar building, and of the familiar faces of those who built, maintain and are testing the Quanji solar building, my mind is stirred and a thousand thoughts well up in it.

Last year, on the eve of the Spring Festival, while taking part in an evaluation conference on integrated solar-heated experimental buildings held in Xining, I had the good fortune to visit the Quanji solar building for the first time. This building is located over 200 li west of Xining at an altitude of 300 meters. Although the atmospheric pressure is low, the atmosphere's transmissivity is very high and the solar radiation is strong. Looking at the deep blue sky and the bright yellow sun, I was very excited: How plentiful the sunlight was here!

The Quanji solar building is a five-room, one-story building which houses the Quanji Post and Telecommunications Office and also serves as the residence for its employees. Although small, it is unique. Its south side is a two-layer glass wall and in addition there is a collector well 1 meter deep. This is a passively solar-heated building which combines direct use of the sunlight with heat-storing walls. When we entered the house out of the bone-chilling wind, we immediately were greeted by a flow of warm air. The mercury showed a room temperature of 10°C. Although this is not a high temperature, there is no auxiliary heat source; With the temperature below -20°C outside, it is by no means simple to obtain an inside temperature of 10°C relying on the sun alone. The comrades of the Quanji Post and Telecommunications Office said that since the solar building was completed in October 1979 they have used no combustion heating, and at dawn on the coldest mornings the room temperature still is about 2°C. In the coal-heated buildings in this area, the early morning temperature can be below freezing.

In addition to using solar energy for heating, the Quanji solar building also has a 100 watt wind-powered generator and a 20-watt photovoltaic panel in its courtyard. Because the wind blows on cloudy days here, and when there is no wind the sun shines, wind-powered electrical generation and solar electrical generation complement each other and meet the Post and Telecommunications Office's electrical power needs for the telephone switching equipment as well as the employees' low-power lighting needs in the evening. This is our country's first experiment in the comprehensive use of solar power, and it has provided this remote area on the Qinghai plateau with valuable experience in the use of solar power.

At the beginning of this year. I paid my second visit to the Quanji solar building as part of a joint test group organized by the Qinghai Province Scientific and Technical Committee for the purpose of carrying out tests of the building's thermal

capabilities. Although only a year had elapsed, I was aware that many changes had taken place. The year before, the dimensions of the window frames and the glass on the south-facing collector windows had not matched, so that much of the glass was butted together, with large gaps, and there was much dust inside, which affected the transmissivity and the heat collecting characteristics. Following reconstruction, the heat collecting windows are tight, the rooms have suspended ceilings, the collector windows have heat retaining curtains, and the convection passages in the heat-collecting walls have been improved. The daily temperature measurements indicate that the heat collection efficiency is much better than the previous year. This winter they again used no auxiliary heat source, and the room temperatures were regularly over 10°C, falling to 5°C on only a few days; the collection efficiency was over 20 percent. A tambour wall filled with sawdust was used as outer insulation; its heat transfer coefficient was only about a third that of ordinary masonry half-walls (this insulating method is suitable for dry climates). The measurements also indicated that solar energy was indeed plentiful here; the total radiation incident on a vertical south-facing wall can reach more than 6,000 kcal/m^2-day, more than half again as great as in Beijing.

One month later I came to Xining again to take part in a technical evaluation of the Quanji solar building. The Qinghai Province Post and Telecommunications Scientific Research Institute, with the support of its sister organizations, had done a great deal of research in the past 2 years, and had made thorough preparations for the technical evaluation meeting. It presented a design report, a test report, a use report, a research summary and a preliminary economic evaluation on the Quanji solar building for consideration by the representatives. During the meeting I paid another visit to the building along with the other conference participants (a new 80-watt silicon solar cell array had been installed). Because considerable attention had been devoted to the economic results of the building, the comrades of the Qinghai Province Post and Telecommunications Research Institute presented an extremely convincing analysis for the representatives. They carried out a week of temperature measurements on the solar house and a nearby coal-heated bank building (the floor area of the bank was 39 square meters, slightly greater than that of the solar heated building). The measurement results indicated that the temperature levels in these two buildings were comparable, butthe room temperature in the bank building was somewhat lower in the morning. The heating season in this area is over 7 months long, and in 1 year the bank used 12 tons of coal, and the 200 kilometer hauling distance for each ton of coal cost over 80 yuan. So in a year the Quanji solar building could save about 1,000 yuan in coal expenses. The additional investment in the passive solar heating portion of the Quanji solar house was about 3,000 yuan, so that this part of the investment could be recovered in slightly over 3 years. Obviously, the economic results were good.

The technical evaluation committee, made up of 30 solar specialists from all over the country, made a conscientious evaluation of the Quanji solar house, and all of them approved the results of this test model and suggested that the experiment be expanded. Many representatives also suggested that additional experiments be included. For example, some of them suggested that water pumps be installed to supply subsurface water (the location is closed to Qinghai Lake and the water table is high), and that solar water heating equipment be installed, allowing our Tebetan brothers in the area to bathe; in addition, there is plentiful windpower here, and some of the participants suggested installing a 2 kilowatts solar generator to provide power for illumination.

The Quanji solar building shows that solar energy is already a viable energy source in the Jiquan area.

8480
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Solar Cells for Railway Signal Power

Beijing TAIYANGNENG [SOLAR ENERGY] in Chinese No 3, 1981 p 20

[Article by Wang Changgui [3769 7022 6311] and Huang Xijian [7806 6932 1017]: "Solar Cells Used for Railway Signal Lights"]

[Text] Railway signal lights are an important piece of equipment for maintaining railway safety and on-time operation. Our country's railways now have more than 5,000 stations, and of these than 1,500 have either no electrical service or no reliable electrical service. These stations' signaling equipment is either kerosene lamps or lights powered by air cell batteries or dry cells. The signal lights' technical characteristics are poor, their operation is not stable, their energy consumption is high, and they are labor-consuming. In order to improve this backward situation and provide a better power source for signal lamps, people have recently begun to use silicon solar cells as a power source.

The Gaolingzi station of the Harbin Railway Office is in a rugged mountain area on a 1.3 percent grade, with a harsh climate and extreme temperatures. On windy, snowy nights, either the kerosene lamps are blown out or the signals cannot be seen because of the limited visibility. The trains generally have no way of approaching the station, and accordingly every year trains have to be stopped outside the station an average of 3 times and guided into the station 50 times, resulting in behind-schedule operation and gravely affecting traffic safety. The station's signal lights use to consume 600 jin of kerosene and 260 jin of soybean oil a year, equivalent to about 400 yuan. After the changeover was made to silicon solar cells, this expenditure was eliminated; the saving over 10 years is approximately equivalent to the cost of the solar cells and nickel-cadmium storage batteries.

The Ket railway station, located between Xining and Ge'ermu on the Qinghai Railway formerly generated all its electricity with a diesel generator. At this high altitude, the air is thin and the efficiency of the diesel engine was decreased by more than 30 percent, so that not only was fuel consumption high, but servicing was particularly burdensome. Currently, silicon photocells are used as a power source; they are easy to operate, save diesel fuel, require almost no servicing, and are extremely economical and convenient.

A silicon solar cell railway signal light system consists of the following parts: 1. a silicon solar cell array; 2. a bank of storage batteries; 3. a power control unit; 4. signal lights; 5. power lines; 6. the tray, frame and tracking apparatus for the silicon solar cell array.

Experience using the solar cells to power railway signal light systems indicates that the voltage is stable, the light is highly reliable and continuous, and not only is extinguishing of the lights prevented, but the visibility is approximately doubled, which is extremely important in assuring safe, on-time railway traffic and modernizing railway operations.

In the future as the cost of solar cells decreases and their lifetime is extended, the use of solar cells in railway signal lights will become more extensive, producing noteworthy technical and economic results.

8480
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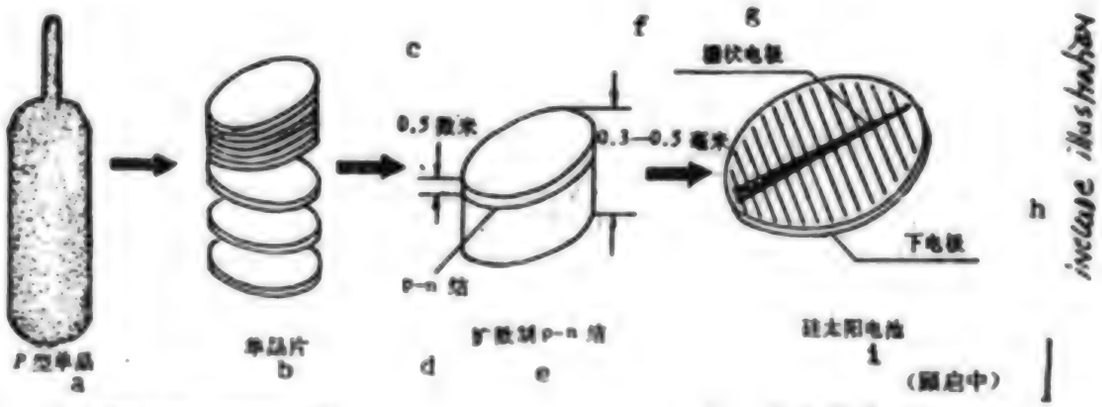
Silicon Photoelectric Cells

Beijing TAIYANGNENG [SOLAR ENERGY] in Chinese No 3, 1981 p 7

[Article by Gu Qizhong [7357 0796 0022]: "A Silicon Solar Photoelectric Cell"]

[Text] The basic material for the manufacture of silicon photocells is monocrystalline silicon. In order to decrease costs, the use of polycrystalline silicon, cast silicon and alloy silicon to produce them is being studied. The process of producing monocrystalline silicon photocells is shown in the figure. P-type (phosphorus-doped) monocrystalline silicon is used as the base material. The monocrystalline rod is cut into wafers, generally 0.3-0.5 mm thick, which are then polished and cleaned to obtain a flat, shiny, defect-free surface. Then the high-temperature diffusion method is used to form a p-n junction at a depth of less than 0.5 microns. The two sides of this junction have particles with different conductivities: electrons and holes (positrons); these attract each other and accumulate a large electric charge, and because there is a positive charge on one side and a negative charge on the other, a field (or potential) from the p side toward the n side is created across the junction. When this electric field exists, if the surface is illuminated the energy of the photons can excite the electrons in the p and n areas to produce electron-hole pairs which accumulate on the two sides of the p-n junction, and if a metal wire is used to connect the device to an external circuit, electric current will flow from the negatively charged area, and solar energy will be converted into electrical energy.



Key:
a. P-type monocrystal
b. Monocrystalline wafers
c. 0.5 microns
d. p-n junction
e. Creation of p-n junction by diffusion
f. 0.3-0.5 microns
g. Grate-type electrode
h. Lower electrode
i. Silicon solar cell

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BIOGAS PROJECTS, USES EXPANDING

Expanded Role Foreseen

Beijing XIANDAIHUA [MODERNIZATION] Vol 3 No 9, 16 Sep 81 pp 4-5

[Article by Wei Lian [1218 1670] and Hui Zheng [1920 2973], Figures by Wang Shuzhang [3769 2885 2874]: "CH_4: The Rising Star of Energy"]

[Text] The Miraculous Ordinary Fuel

Imagine a fuel that has a greater reserve than oil, produces less pollution than coal, is safer than nuclear energy in power production and is more direct than solar energy. Sound like a miracle? Actually, millions of people have been using it. This fuel is plain old biogas, a colorless and odorless combustible gas known as methane (CH_4) in chemistry and is the simplest hydrocarbon consisting of a carbon atom surrounded by four hydrogen atoms. Nevertheless, many experts believe, methane will play an important role in alleviating the energy crisis, and satisfy people's energy needs for a sufficiently long time until immense energy sources such as nuclear fusion and solar energy can be developed and applied on a large scale.

At the mention of biogas, people often think only of the biogas produced by biochemical reaction from plants and manure in rural villages. Actually methane is ubiguitous. The main ingredient of natural gas is methane, so is the gas in coal mines. Of course, methane can also be produced artificially from coal, manure, garbage, and plants. Like oil and coal, biogas is produced by the decomposition of biological remains in an air-free environment, a microbiological process that has been occurring and will continue to take place. This process has formed underground gas reserves in every geological age. Today, millions of bacteri in the soil are continuing converting organic matters into great amount of biogas. Methane was first discovered in swamps and hence the name biogas or swamp gas. It escapes from the humus soil at the bottom of the swamp and repeatedly rises to the water surface as bubbles.

The Formation of Biogas

The common procedure of artificial fermention to produce biogas is a complicated biochemical process. It can be roughly divided into two stages: decomposition and reduction.

In the first stage, bacteria decompose complex organic matters such as hydrocarbons, cellulose, fruit acid, protein and fat into simple organic material such as ethyl acid, lactic acid, butyric acid, methanol, ethanol, and butyl alcohol and inorganic matters such as carbon dioxide, hydrogen gas and hydrogen sulfide. Bacteria for this stage include cellulose decomposition bacteria, fat decomposition bacteria, protein decomposition bacteria, and pectin decomposition bacteria, with the principal one being butyric acid fermentation of cellulose.

In the second stage, bacteria oxidize or reduce the simple organic matter produced in the first stage and carbon dioxide into methane. The bacterium responsible for this process is the methane bacterium, which causes the simple organic matters to react with water and decompose to produce methane:

$$(C_6H_{10}O_5) + nH_2O \xrightarrow{\text{methane bacteria}} 3nCH_4 + 3nCO_2 \text{ heat}$$

The methane bacteria can decompose butyric acid and ethyl acid into methane, oxidize ethanol and reduce carbon dioxide into methane and organic acid, and can cause the hydrogen gas to reduce carbon dioxide into methane. In short, the generation of biogas can be summarized as follows: complex organic compounds are first decomposed by bacteria into simple organic acids, alcohol and carbon dioxide, which in turn are oxidized or reduced by bacteria to produce methane.

Close Relation with Other Fossil Fuel

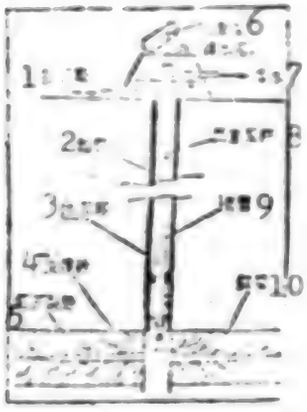
Methane is closely related to other forms of fossil fuel. The great developments of natural gas today are at regions that were originally oil field developments. Engineers are also exploring potential gas fields locked in sandstones; however, natural gas can only be separated from sandstones at great costs and there is not yet a perfected technology to do so.

Oil shale contains not only petroleum but great amounts of natural gas as well, may be as much natural gas to last half a century. The problem is that natural gas is locked in the oil shale and cannot be easily drilled and piped to the ground surface like in ordinary oil fields.

In the United States, a University of Texas team is experimenting the extraction of steam from the high temperature high pressure saline water 10,000-16,000 feet under ground and uses the steam to drive a gas turbine to generate electricity. Underground saline water is saturated with methane which rises to the surface along with steam and the pressure may be as high as 12,000 pounds per square inch. Researchers are exploring ways to separate out the natural gas before the steam is fed into the gas turbine. There are also people who believe that the priority should be the separation of natural gas and geothermal steam that accompanies the natural gas should be used as a byproduct. According to the estimate of Jones, an American Academy of Sciences Scientist, natural gas obtained in this manner may last 500 years.

Natural gas also coexists with coal, known to the miners as gas. It poses a great threat to the miners and may lead to casualties in case of explosion. Researchers are currently studying solutions to two simultaneous problems: venting the gas out

of the coal mines and recovering the gas as a fuel. In a coal mine near Waynesburg, Pennsylvania in the United States, a drilling team bored into 800-1,200 feet deep coal seam with an 8-inch diameter drill bit and pumped in high pressure mixture of water and sand through a pipe in the bore hole. After the coal seam is cracked, the water is pumped out and the sand stays in place to wedge open the crack in the coal seam. A number of 200-300 feet long cracks are formed and gas is brought to the surface through these cracks and through the pipe in the drill hole, see Figure 1. This drilling team drilled a gas well that produces 60,000 cubic feet of gas per day. A nearly high performance gas well only produces 10,000 cubic feet of gas per day.



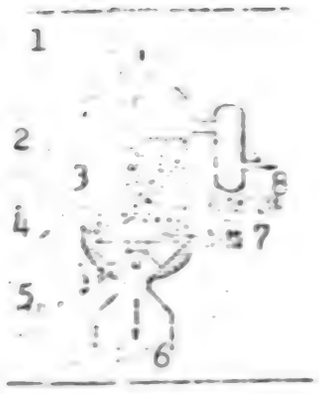
Key
1. Pumping out gas
2. Oil pipe
3. Concrete ring
4. Sand wedge
5. Forces the crack open
6. Piston pump (for water drainage)
7. Water drain
8. Piston rod
9. Sleeve
10. Coal seam

Figure 1

Fabulous Skills

Methane can also be produced directly from coal by a chemical method known as coal gasification. Low heat value coal can be used as raw material in coal gasification.

Coal gasification is a thermochemical process, it uses carbon and hydrogen contained in coal as raw material, oxygen, water steam, and carbon dioxide as gasification media and, through a minimum oxidization process, carbon and hydrogen are converted into combustible gases such as carbon monoxide, hydrogen and methane. In different gasification methods and techniques, the chemical reactions are different and the methane content in the product gas is also different. Generally, if the gasification is conducted under normal pressure, carbon dioxide, carbon monoxide, hydrogen and water steam are obtained; if the gasification is carried out under pressure, methane and hydrogenated methane are obtained, see Figure 2.



Key
1. Intake
2. Preheating layer
3. Gasification layer
4. Combustion layer
5. Gasification medium (water steam, oxygen, etc.)
6. Residue outlet
7. Furnace grate
8. Combustible gas

Figure 2

Major chemical reactions leading to the production of methane are:

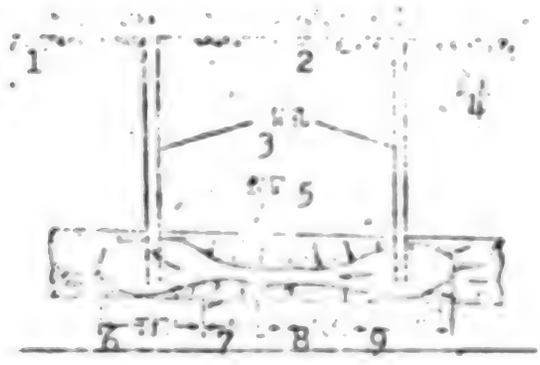
$$C + 2H_2 \rightleftharpoons CH_4 + \text{heat} .$$

$$CO + 3H_2 \rightleftharpoons CH_4 + H_2O + \text{heat} ,$$

$$CO_2 + 4H_2 \rightleftharpoons CH_4 + 2H_2O + \text{heat},$$

$$2CO + 2H_2 \rightleftharpoons CH_4 + CO_2 .$$

The first generation of ground surface coal gasification plants are already built. The U.S. government is also funding researchers at Lawrence Livermore Laboratory for the study of two usual gasification methods that may be more efficient. In one method, the underground unmined coal is heated and the methane gas produced is piped to the surface for further processing, see Figure 3. In the other method, solar energy is used to heat the coal directly by means of a complicated lens arrangement and causes gasification.

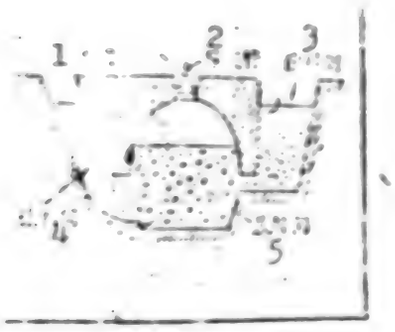


Key
1. Pumping out combustible gas
2. Pumping in gasification medium
3. Drill holes
4. Ground surface
5. Coal seam
6. Drying
7. Coking
8. Gasification
9. Bruning

Figure 3

Microbiological method is identical to the process in which swamp gas is formed in nature. Farms and garbage and sewer processing plants can all provide biogas. All that is required in producing biogas with naturally occurring bacteria is a constant supply of organic matters and a oxygen-free environment. Peasants load human waste,

animal manure and straw of crops into a large air-tight decomposition container and maintain a certain moisture, temperature and pH value, biogas is produced after fermentation and decomposition by the bacteria. Biogas is taken out through a pipe at the top of container, as shown in Figure 4. Large biogas pools can be built in the cities to produce biogas from garbage on a large scale. It is estimated that if half the garbage is used to produce biogas, 1/5 of the natural gas demands in the United States can be satisfied.



Key
1. Gas plug
2. Gas pipe
3. Outlet chamber
4. Inlet chamber
5. Fermentation chamber

Figure 4

Branches and leaves of plants and organic waste of factories can also be used in the production of natural gas with suitable catalysts. It has also been suggested that seaweeds and water hyacinth can be converted into biogas.

Why hasn't biogas become today's major energy source? Experts believe there are technological as well as ideological reasons. In the technological aspect, great efforts are yet required in the development and exploitation of biogas as an energy resource and the costs need be greatly reduced. A more serious problem is that biogas has been neglected by people; however, as the energy crisis becomes more acute, people will undoubtedly reconsider the prospects of this form of energy resource and biogas will become one of the pillars of future energy resources.

9698
CSO: 4006/52

Methane Gas Widely Used in Jiangsu

Nanjing XINHUA RIBAO in Chinese 15 Aug 81 p 1

[Article by Wang Jianguo [3769 1696 0948]: "Methane Gas Finds Wider Usages in Jiangsu Villages"]

[Text] Methane gas is finding increasingly wide use in rural villages in Jiangsu Province. Methane is not only used in cooking and lighting, it is also used to grow seedlings in greenhouses, to power grain threshers, to process food and feed and to dry tea leaves.

Today there are 700,000 rural households in Jiangsu Province using methane gas in their cooking and lighting. This has saved a great amount of energy for the country, reduced the economic burden of commune members and promoted agricultural production. More than 300 methane gas electric power stations have been built in Jiangsu which produce almost 2 million kilowatt-hours of electricity every year. In 1981 all the production brigades equipped with methane gas electric stations have generally completed their three wheat grain threshing tasks ahead of schedule because of the uninterrupted supply of electric power. In some production brigades the power generated with methane is used to operate food and feed processing plants, providing convenience to the commune members and increasing the collective income. The Qingshan tea plant in Gaochun County uses electric power generated from methane as a substitute for coal in tea production, and the tea quality has been improved. The Douzhuang middle school in Danyang County built a methane gas electric power generating station using the dejecta at the school. They have not only solved the school lighting problem but have also built a small plastics processing plant and generated 100,000 yuan of profit. The Wansui commune in Wujin County has built some 20 methane power stations; when the voltage is unstable during the peak hours at night, the commune members connect up the methane electric source and watch television programs.

The application of methane gas fertilizer is also widening. Some places use methane gas fertilizer liquid to hatch fish, grow flowers, nurture pearl clams and mix it with pesticide for use as a spray; all have worked well. The Baijiahu hatchery in Nanjing municipality uses the draff from the methane gas to raise fish; they have found that the fry grow rapidly and their disease rate is reduced. In Wujin, Wuxi and Shazhou, precipitated draff from methane gas production is used to feed mushrooms. This practice has broadened the material base for growing mushrooms and has become an important avenue for diversified business in rural villages.

9698
CSO: 4006/496

Shoddy Construction Hobbles Digester Projects

Beijing RENMIN RIBAO in Chinese 16 Aug 81 p 1

[Article: "Almost 2,000 Biogas Digesters Built in Jilin"]

[Text] In the first 6 months of 1981 more than 1900 biogas digesters have been built in Jilin Province. Many of the rural areas in Jilin are short of firewood and peasants have been looking forward to using biogas at an earlier date. However, from 1975, when the pilot program began, to the end of 1981, only 1,000 biogas digesters were built in the 6-year period. In 1981, people at various places in Jilin consolidated the experience and lessons learned from the slow development of biogas and realized that the key issue is the construction quality of the biogas digesters. In many places the biogas digesters can be described as "hot for the first year, cold in the second year and fizzled out after 3 years". As a result, the enthusiasm of the public toward developing biogas was frustrated and they tend to shy away from biogas no matter how strongly it is advocated, even when they are presented with money. Therefore, efforts are made to improve the

construction quality of the digesters so that every unit built is a useful one. Now that the public has benefited from biogas, they are now urging the cadres to build biogas digesters.

In less than 6 months, Yushu brigade of Dagushan commune in Yitong county built another 80 biogas digesters.

9868
CSO: 4006/31

GEOTHERMAL RESOURCES SURVEYED, DEVELOPED

Xizang Autonomous Region

Beijing XINHUA in English 0713 GMT 24 Oct 81 OW

[Text] Lhasa, 24 Oct (XINHUA)--Hot springs or places with potential geothermal resources have been discovered in 66 of 74 counties in the Xizang Autonomous Region, according to the Xizang Geological Department. Thus, Xizang ranks first in China in geothermal resources. Of the 600 hot springs in Xizang, 30 are hotter than the local boiling point of 85 degrees centigrade, the department said. A recent survey of 375 springs showed that the total energy they release in a year is equivalent to the burning of 7 million tons of coal. An experimental geothermal power station was set up in 1977 in Yangbajain. Its first 1,000-kilowatt generating unit has been in operation for 26,000 hours and generated 8.9 million kilowatt-hours of electricity. Installation of a second 3,000-kilowatt generating unit will be completed soon.

CSO: 4020/26

Low Resistivity Layers

Beijing XINHUA in English 0710 GMT 31 Oct 81 OW

[Text] Lhasa, 31 Oct (XINHUA)--Recent surveys by Chinese and French geologists in Xizang's Yangbajain geothermal field, one of the world's largest, have revealed three low resistivity layers in the shallow strata in the earth's crust which they presumed to be the three geothermal reservoirs there. The geologists were in Xizang under the terms of a 1978 Sino-French scientific cooperation agreement. Their explorations in the 15-square-kilometer field, 90 kilometers north of Lhasa, revealed three low resistivity layers at different depths. The first is 1 to 2 kilometers below the surface, the second 5 to 6 kilometers deep and the third 14 to 18 kilometers, the team said. Since 1975, 21 exploratory boreholes and production wells have been drilled in Yangbajain. An experimental power station was built in 1977 with a generating capacity of 1,000 kilowatts. A second station with a capacity of 6,000 kilowatts is now under construction.

CSO: 4020/33

TIDAL ENERGY FOR POWER GENERATION BEING DEVELOPED

Beijing XINHUA in English 0725 GMT 14 Nov 81 OW

[Text] Beijing, 14 Nov (XINHUA)--China could produce 58,000 million kilowatt-hours more electricity each year by using tidal energy, announced a Shanghai science forum last week. The figure was based on surveys in the past 2 years of 156 bays and 33 river mouths from the mouth of the Yalu River that separates China from Korea to where the Beilun River empties into the Beibu Gulf in Guangxi Zhuang Autonomous Region in China's far south. Chinese scientists have also reexamined surveys, designs and other work from 1958 to 1979 for exploitation of tidal energy. China's first experimental tidal-energy electric power station went into operation in May last year in Zhejiang Province, east China.

CSO: 4020/33

MAKING FULL USE OF WINDPOWER RESOURCES URGED

Strengthened Leadership

Beijing GUANGMING RIBAO in Chinese 18 Sep 81 p 1

[Article by Xie Jun [6200 6511]: "Windpower Specialists Suggest That Government Should Strengthen Leadership To Make Full Use of China's Windpower Resources"]

[Text] More than 100 windpower experts of China suggested recently that the governmental department in charge should strengthen leadership to change the backward state of windpower utilization in China today, to make full use of China's windpower resources, and to let the windpower manifest its economic effect on the four modernizations construction.

This suggestion was made at the first symposium on the utilization of windpower held in China which was just concluded. The symposium considered that China is quite behind in the utilization of windpower and its research standard is low. The main problem consists of the lack of leadership and unified planning, so that everyone does his own thing without communication, resulting in scattered forces and repetition of low standard works. Therefore, the windpower experts suggested that the governmental department in charge should draft China's windpower development plan with experts from various scientific fields participating in the drafting, take measure to concentrate properly the scientific research forces with united planning of the research funding, in order to improve the overall cooperation and to raise the standard of windpower research steadily. At present, the emphasis should be placed on the development of simple, durable and cheap windmill machines in order to provide windpower machinery to those areas where regular energy sources are unavailable such as remote farming and animal husbandry districts and islands. As to those small-scale windpower machines which have already been successfully developed and authenticated, there must be a corresponding technical policy supporting their quantity production and promoting their application step-by-step. At the same time, to cultivate technological reserve, a preliminary research work on medium- and large-scale windpower machines must also be planned and carried out systematically.

9113
CSO: 4006/51

20-Kilowatt Generating Set

Harbin Heilongjiang Provincial Service in Mandarin 1100 GMT 24 Oct 81 SK

[Text] The Heilongjiang machinery industry institute has successfully developed China's first 20 kilowatt generating set. The generating set has been in operation for 600 hours, producing 6,500 kilowatts of electricity. Suitable for use in cold areas at high altitudes, this new product will contribute to utilizing our country's wind power resources and solving the power shortage in the grasslands.

CSO: 4006/130

NEW ENERGY CONSERVATION TECHNIQUES PROMOTED

'Energy Conservation Month'

Beijing GUANGMING RIBAO in Chinese 24 Oct 81 p 1

[Article: "More Energy from Better Management, More Energy from Better Technology; The Economic Commission, The Planning Commission and The Energy Commission Kick Off the Third "Energy Conservation Month," Emphasizing that Energy Conservation and Implementation of Economic Responsibility System Must Be Coupled With the Reform of a Phenomenon: Enterprises "Eating From a Big Pot"]

[Text] The State Economic Commission, the State Planning Commission and the State Energy Commission have decided that all departments and districts nationwide shall kick off activities related to the third "energy conservation month" in November.

China's first "energy conservation month" activities began in 1979. In the 2 years or so since, all districts and departments nationwide have combined the activities related to "energy conservation month" with the routine energy conservation work and achieved outstanding results in the field of energy conservation. Energy equivalent in amount to 23.6 million tons of standard coal was conserved nationwide in 1979; 35 million tons of standard coal in 1980; and 14.6 million tons of standard coal in the first half of 1981. It is anticipated that the task of conserving 24 million tons of standard coal this year nationwide will be overfulfilled. However, the work related to energy conservation has just begun in China with the foundation of managing energy resources still very fragile, and the phenomenon of "eating from a big pot" in matters related to the utilization of energy resources has not yet been resolved, so that great potential exists for further conservation.

In order to get activities related to the third nationwide "energy conservation month" off to a good start, the State Economic Commission and other related agencies held a special conference today in which persons in charge of various industrial and transportation agencies under the State Council participated in making preparatory arrangements for the implementation of energy conservation work.

1) Strengthen leadership, promotion and supervision of energy conservation. The leading comrades of every district, every department and every enterprise as well as the leading comrades directly in charge of production must incorporate the energy conservation work with the entire production process from beginning to end.

During the planning stage of a production process, energy saving arrangements must also be made; during the process of inspecting production, the energy saving measures must also be inspected; and when the results of production are reported, the effectiveness of energy conservation measures must also be reported. During the "energy conservation month" every district and every department must motivate the masses to review the results of energy conservation in the light of the documents concerning energy conservation handed down by the Party Central Committee and the State Council, summarizing and spreading the good experiences while criticizing and assisting the backward.

2) More energy from better management, more energy from better technology. During the "energy conservation month," every province, every city, every autonomous region and every department must conscientiously inspect its own subordinate enterprises for proper management of energy conservation work, including inspection of instruments used, the measurements, statistics, quota management, and accomplishment of energy conservation tasks. Find out and provide measures to solve the problems wherever they are so that the unit energy consumption may be brought down as soon as possible. Those enterprises which consume large quantities of energy while their products are not in great demand should take decisive action to shut them down or stop production immediately. The Ministries of Machine Building must make plans to phase out those facilities which waste too much energy.

3) Energy conservation measures should be coupled with the economic responsibility system in order to eliminate the phenomenon of enterprises "eating from a big pot" on matters related to energy conservation. In the future, production must be encouraged according to whether the production norm is advanced or backward. Fuel must be distributed according to the norm while the enterprises must adopt an energy contract system, in which the savings in energy are returned to the enterprises. During the "energy conservation month," every department must carry out investigation and study in order to establish concrete standards for various enterprises on matters related to energy conservation and to develop methods for implementing energy contract system.

4) Enterprise energy equilibrium plans must be conscientiously implemented at a faster pace. Every district and every department must, during the "energy conservation month," make special effort to implement the plan to achieve enterprise energy equilibrium, to improve the quality of its work and to give a big push to this plan by modifying the measures, if necessary.

It was also suggested during the conference that every department under the State Council should dispatch work groups to the districts during the "energy conservation month," and to work closely with the districts so that the third "energy conservation month" activities may be carried out impressively and solidly.

9113
CSO: 4006/66

Reduce Oil Consumption

Beijing RENMIN RIBAO in Chinese 30 Sep 81 p 1

[Article: "State Planning Commission Calls For Further Reductio in Oil Consumption"]

[Text] The national conference on oil conservation and consumption reduction recently concluded in Beijing asked all the provinces, municipalities, autonomous regions and agencies under the State Council to overcome their indecisive wait-and-see attitude and to take effective measures in further promoting oil conservation and consumption reduction efforts and achieving greater results.

Representatives attending the conference believe that although there have been some achievements in the oil conservation drive, wastes in oil consumption are still serious and potential for further conservation is still great. For example, the thermal efficiency of some steel mill furnaces is only 8 to 10 percent, and every ton of rolled steel consumes as much as 300 kilograms of oil, which is more than 4 times the oil consumed by a regular furnace. Some glass plants use 17 kilograms of oil for each crate of glass produced whereas other glass plants working under similar conditions consume 59 kilograms of oil.

The conference called upon the provinces, municipalities, autonomous regions and agencies of the State Council to strengthen their leadership and continue to improve their oil conservation and consumption reduction with a keen sense of political responsibility and with the national economy interests in mind. All oil-burning industrial and civilian boilers and power station boilers designed to burn coal and later modified to burn oil must be converted to burn coal, and the conversion must be completed by 1985 at the latest. As for the power station boilers originally designed for oil burning, they should be modified to burn coal whenever possible, or high efficiency power generators should be built to replace them. Various types of oil-burning industrial furnaces and kilns should be systematically modified according to some schedule based on the local situation in the enterprise. Oil fields, refineries and their affiliated enterprises and business units that have been burning oil should be converted to burn coal according to schedule and by turns.

In order to further improve the effort of reducing oil consumption, it was determined in the conference, and approved by the State Council, that henceforth oil conservation projects shall be budgeted directly as national capital construction projects and equipment and materials required in the conversion will be completed and allocated as capital construction projects. Coal needed by enterprises with converted boilers and furnaces will be handled as a special project from distribution to requisition and contracts will be assigned to assure its supply.

This conference was jointly held by the State Planning Commission, the State Economic Commission, the State Energy Commission and the State Supply Bureau. Vice Premier Yu Qiuli [0151 4428 6849] attended and addressed the conference.

9698
CSO: 4006/33

Zhejiang Major Conservation Measures

Beijing RENMIN RIBAO in Chinese 26 Aug 81 p 1

[Article: "Zhejiang's Effective Energy Conservation Steps Produce Results"]

[Text] Industrial departments in Zhejiang Province are treating energy conservation as a key to developing production and have achieved good results by taking effective measures. In the first 6 months of 1981, the Zhejiang industrial system has saved 200 million kilowatt-hours of electrical energy, 230,000 tons of coal and 23,000 tons of oil. Although the energy supply is 1.27 percent less than that of the same period last year, total industrial production was increased by 1.548 billion yuan over the same period of 1980.

The following are the major energy conservation measures in Zhejiang:

--By establishing a healthy economic responsibility system, energy conservation targets are put on a solid basis at every level. Establish and promulgate energy consumption quotas for unit producing major industrial products, establish a level-by-level evaluation system and make a monthly check of the energy consumption by major industries.

--A series of codes and regulations conducive to energy conservation were established based on pertinent national regulations and taking into account the actual circumstances in Zhejiang. For example, they drafted and published "Temporary Regulations of Energy Management in Zhejiang Province" and "Tentative Rules Regarding Conservation Awards for Special Fuel and Raw Materials in Industrial and Transportation Enterprises" and promoted the development of energy conservation.

--Conduct thermal energy surveys for major industries and plan and carry out heat balancing for big energy consumers to improve the utilization rate of energy resources.

--Establish conservation service companies to provide technical consultation and technical service for conservation efforts throughout the province.

--Provide technical training for boiler operators throughout the province.

--Adjust the product structure, suppress the energy intensive and unsalable heavy industrial products and develop the less energy consuming, salable consumer goods. Use our limited energy resources where they count most.

9698
CSO: 4006/33

Guangdong Conserves Coal

Guangzhou NANFANG RIBAO in Chinese 13 Aug 81 p 1

[Article: "New Conservation Techniques Allow Guangdong To Conserve 100,000 Tons of Coal"]

[Text] In recent years Guangdong Province has promoted the application of new technologies, including far infrared drying, aluminum silicate fiber, and an automatic coal feeding device for boiler furnaces, and has obtained good results. According to estimates made by the provincial promotion station for industrial and communication technology, the energy saving per year is equivalent to 100,000 tons of standard coal. The manager of the station told the reporter the other day that conserving energy by scientific techniques is an important avenue to resolve the energy supply and demand conflict in Guangdong Province.

The technique of radiation heating and drying with far infrared was promoted relatively early and has now spread to almost 1,000 plants and enterprises, wherever electric heating and drying are required in the province, and has achieved 20 to 40 percent energy saving. Just from this one item Guangdong Province saved 70 million kilowatt-hours of electrical energy a year, equivalent to 30,000 tons of standard coal. Recently in some plants aluminum silicate fiber insulation has been used together with far infrared heating, and the effects have been even better. For example, the Hongxing pharmaceutical plant in Chaozhou municipality achieved a 50-percent saving of electricity by using far infrared in its vibrators and another 21.5 percent by using aluminum silicate fibers as thermal insulation; its actual electric consumption is only one-third that before the improvement.

Aluminum silicate fiber is a new thermal insulation material that is even more heat-resistant than asbestos or glass wool. Like far infrared radiation, the fiber also possesses the following advantages: low investment, quick result, mature technology, not difficult to adapt and adequate supply of material and equipment. Hence, it has quickly received wide application and has been used by more than 300 plants in many counties and cities in professions such as plastics, rubber, leather, ceramics, glass, food, medicine and electronics. Sometimes the fibers are used as an inner insulation sheath in tubes, and in other cases they are used to fill and seal jackets of furnaces and kilns or used as external insulation. Generally they can provide a 20 to 40 percent energy saving and they are an emphasized promotion item in Guangdong Province in 1981.

Guangdong has a lot of low grade coal, and many enterprises use boiler furnaces that burn low grade coal to meet this situation. But coal is fed into the boiler furnace simply on the basis of workers watching the condition of the flame. The furnace temperature is hard to control, scarring and die-out are likely, and more coal is used than necessary. To overcome this technical bottleneck, chemical meter plant No 2 of Jiangmen municipality developed an automatic coal feeding device based on a technical innovation at Kaiping nitrogen fertilizer plant. The new device automatically regulates the rate of coal feeding to insure the normal operation of the furnace. It not only assures product quality but also conserves energy. Two tons of coal can be saved in a 10-ton furnace, and the cost of installing this device can be recovered in 3 months. According to incomplete statistics, more than

100 boiler furnaces in the chemical, paper and print and dye industries in Guangdong Province have employed this device, saving 700,000 to 800,000 tons of coal a year.

In the past few months, experience exchange meetings have been held in Guangzhou municipality and in the Shantou, Zhanjiang and Foshan areas to further promote the application of new energy conservation techniques. In addition to those described above, items for promotion also include noiseless operation of AC contacts, automatic compensation of power factor, silicon-controlled speed regulation and bottomless valve water pump.

9698
CSO: 4006/495

Nanjing Refinery Conservation Efforts

Nanjing XINHUA RIBAO in Chinese 27 Jul 81 p 1

[Article by Xie Zhiliang [6200 2784 2733] and Zhou Zhengrong [0719 2973 2837]: "Nanjing Refinery Obtains New Results in Conserving Energy"]

[Text] After shooting flames day and night for over 10 years, the "sky light" of Nanjing refinery was turned off in April 1980. In the 15 months since this energy conservation measure was taken, 100,000 yuan of fuel gas has been saved.

Nanjing refinery takes energy conservation seriously. Since 1979, its energy saving has been equivalent to 80,000 tons of fuel oil and it has been evaluated "energy conservation progressive unit" by Jiangsu Province, Nanjing municipality and the Ministry of Petroleum.

Turning off the "sky light" is another important energy-saving achievement of Nanjing refinery. In the petroleum refinery process a combustible gas is released into the atmosphere; since this gas pollutes the air, it must be burned. This is how the "sky light" is produced and it is a form of wasted energy. For many years people believed it was "very difficult" to put out the "sky light". Last year the plant cadres and technical staff were determined to solve this problem. They studied and took a few measurements and extinguished the "sky light" at an expense of only 2,000 yuan. Today they are continuing their efforts to recover other combustible gases released into the atmosphere.

In the past 2 years Nanjing refinery has continued to achieve energy conservation results. One important reason is that it assigns energy conservation measures and targets in the same way it assigns production projects, and energy conservation achievements are evaluated the same way production results are evaluated. In 1980, the refinery made 35 energy conservation assignments and took 100 specific measures, all of which were accomplished by the end of the year. Another 93 energy-saving projects have been assigned this year and they are being carried out according to plan.

In its conservation efforts, the Nanjing refinery pays attention to the little as well as the large. Because the budget for energy-saving technical measures is

limited, the plant weighed its priorities and went for high points on major energy conservation projects; in the meantime, it carried out a variety of small improvements and modifications according to the specific condition and situation. In 1980, while major energy-saving modifications of the second set of constant pressure drop distillation devices were being worked on, a series of simultaneous small improvements were made using new types of burners and adjustment of the pump load. Without spending 1 cent of the technical operation fund, the device energy consumption was reduced by 5.3 percent, saving the equivalent of 5,200 tons of fuel oil in a year.

The refinery has also implemented energy conservation awards. The method is to assign energy conservation targets to the shop and put them solidly on a shift and individual basis. Evaluations are made and money is awarded based on the scores given to accomplished results. Very good results have been obtained.

9698
CSO: 4006/496

Briefs

SHANGHAI ENERGY CONSERVATION--During the period from January to September this year, Shanghai's industrial enterprises lowered their energy consumption per 1 yuan of industrial output value by 2.1 percent compared with the same period last year. The total energy conserved during this period was equivalent to 300,000 dun of standard coal. However, waste of energy is very common. The Shanghai municipal energy conservation group and the Shanghai municipal economic committee have issued a circular calling on all industrial enterprises to make greater efforts to conserve energy during the third energy conservation month, a nationwide campaign in November. [Shanghai City Service in Mandarin 1130 GMT 31 Oct 81 OW]

CSO: 4006/130 END

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Dec. 31, 1981